Washington Sustainable Schools

Protocol for High Performance School Facilities

WORKING DRAFT

Washington Sustainable Schools

Protocol for High Performance School Facilities

Prepared by:

Advisory Committee:
Carter Bagg, Office of Superintendent for Public Instruction (OSPI)
Tom Bassett, The DOH Associates
Gordon Beck, Office of Superintendent for Public Instruction (OSPI)
Brian Carter, INTEGRUS Architecture
Amy Cortese, Northwest Energy Efficiency Alliance
Mike Currie, Bainbridge School District
Peter Dobrovolny, Seattle City Light/Green Building Council
Vern Enns, HBB Consulting Mechanical Engineers
Greg Hepp, Bassetti Architects/Green Building Council
Dave Hewitt, Northwest Energy Efficiency Alliance
Colin Jones, Northwest Architectural Co. /Green Building Council
Kas Kinkead, Cascade Design Collaborative
Merle Kirkley, Chas. H. Beresford Co.
Kyle Kobel, Northwest Energy Efficiency Alliance
Peter Meyer, Tacoma Power
Forrest Miller, Lake Washington School District
Gary Miller, Office of Superintendent for Public Instruction (OSPI)
Kathleen O'Brien, O'Brien & Company
Ralph Saxton, Saxton, Bradley
Stuart Simpson, State of Washington Dept. of General Administration/Green Building Council
Jason Smith, MW Consulting Engineers
Pete Wall, Tacoma School District
David Weigand, New Buildings Institute

Development Team:

Zelaikha Akram, Eley Associates
Kimberly Got, Eley Associates
Rebekah Henderson, O'Brien & Company
Katherine Morgan, O'Brien & Company
Kathleen O'Brien, O'Brien & Company
Arman Shehabi, Eley Associates
Jane Simmons, O'Brien & Company
David Weigand, New Buildings Institute

School Facilities and Organization
Office of Superintendent of Public Instruction
William T. Panos, Director

Dr. Terry Bergeson
Superintendent of Public Instruction

Marty Daybell
Deputy Superintendent, Administration and Operations

March 2004

WORKING DRAFT

Office of Superintendent of Public Instruction
Old Capitol Building
P.O. Box 47200
Olympia, WA 98504-7200

For more information about the contents
of this document, please contact:
Carter Bagg, OSPI
E-mail: cbagg@ospi.wednet.edu
Phone: 425.503-5424

To order more copies of this document,
please call 1-888-59-LEARN (I-888-595-3276)
or visit our Web site at http://www.k12.wa.us/publications

Please refer to the document number below for quicker service:
04-0012

This document is available online at:
http://www.k12.wa.us/SchFacilities/default.aspx

Washington Sustainable Schools

Protocol for High Performance School Facilities

March 2004

ACKNOWLEDGEMENTS

Advisory Committee

The Washington Sustainable Schools Protocol for High Performance Schools was developed under a collaboration of many agencies and organizations within the State of Washington and the Pacific Northwest.

The following individuals participated on the Washington Sustainable Schools Advisory Committee and provided valuable guidance and support for the project.

Carter Bagg, Office of Superintendent for Public Instruction (OSPI)
Tom Bassett, The DOH Associates
Gordon Beck, Office of Superintendent for Public Instruction (OSPI)
Brian Carter, INTEGRUS Architecture
Amy Cortese, Northwest Energy Efficiency Alliance
Mike Currie, Bainbridge School District
Peter Dobrovolny, Seattle City Light/Green Building Council
Vern Enns, HBB Consulting Mechanical Engineers
Greg Hepp, Bassetti Architects/Green Building Council
Dave Hewitt, Northwest Energy Efficiency Alliance
Colin Jones, Northwest Architectural Co. /Green Building Council
Kas Kinkead, Cascade Design Collaborative
Merle Kirkley, Chas. H. Beresford Co.
Kyle Kobel, Northwest Energy Efficiency Alliance
Peter Meyer, Tacoma Power
Forrest Miller, Lake Washington School District
Gary Miller, Office of Superintendent for Public Instruction (OSPI)
Kathleen O'Brien, O'Brien & Company
Ralph Saxton, Saxton, Bradley
Stuart Simpson, State of Washington Dept. of General Administration/Green Building Council
Jason Smith, MW Consulting Engineers
Pete Wall, Tacoma School District
David Weigand, New Buildings Institute

Development Team

New Buildings Institute, O'Brien & Company, and Eley Associates developed this manual under contract to the Northwest Energy Efficiency Alliance.

Project Manager: **David Weigand**, New Buildings Institute

Contributing Authors: **Kathleen O'Brien, Katherine Morgan, Rebekah Henderson and Jane Simmons**, O'Brien & Company
Arman Shehabi, Eley Associates
David Weigand, New Buildings Institute

Layout/Production: **Zelaikha Akram and Kimberly Got**, Eley Associates

WASHINGTON SUSTAINABLE SCHOOLS PROTOCOL

The Washington Sustainable Schools Protocol is partially based on the California Collaborative for High Performance Schools (CHPS) Protocol model and other green building design and construction models, but explicitly defines a high performance school for the State of Washington. This protocol was created by a joint committee representing the professionals that plan, design and construct schools in Washington with considerations for process, economics and climates unique to Washington. This protocol is most useful as a goal-setting and planning tool. Districts can use it to simply and clearly communicate their design goals. At the same time, the protocol's flexibility allows designers to deliver a Washington Sustainable School while managing the regional, district, and site-specific constraints of the school design.

Eligibility Levels and Documentation

The protocol is flexible and address all aspects of high performance schools such as energy efficiency, water efficiency, site planning, materials and indoor environmental quality. In each area, the system is composed of both prerequisites and optional credits. Points are assigned to each credit. To be eligible, a school must meet all of the prerequisites and earn at least 38 points (at least 4 points must be from the Energy category and no more than 4 points from the Extra Credit category). The Washington Sustainable Schools system is pass/fail. However, school district planners are encouraged to earn as many points possible and appropriate for a project above the required threshold.

As documentation, design teams must complete a report that identifies with a brief narrative the approach used to earn each point. Each design team or building owner will document compliance with the protocol through a process of self-evaluation. Documentation reports must be sent to the Office of Superintendent for Public Instruction (OSPI). However, Washington Sustainable Schools stakeholders or other government agencies may sponsor programs where meeting these criteria is required for participation. In these cases, the program administrators may require that documentation be submitted for a thorough review. Example programs include financial incentives (such as the Washington State Schools Pilot Program), accelerated plan review, and/or bonus points for state funding.

A Protocol Scorecard has been included at the end of this document. The scorecard summarizes the requirements and applicable points for each credit.

Washington Sustainable Schools and LEED™

The Washington Sustainable Schools (WSS) Protocol is similar to the US Green Building Council's (USGBC) LEED™ 2.1 Rating System. However, no interchangeability between the two systems is expressed or implied at this time. A school qualifying for Washington Sustainable Schools may contain many of the elements needed for LEED™ certification, but there is currently *no formal* reciprocity between the two systems. Schools qualifying for CHPS may or may not officially qualify for LEED and vice versa. Teams wishing to pursue a LEED™ rating must do so independently. However, the USGBC has developed excellent support materials, which are referenced by Washington Sustainable Schools. In particular, the LEED™ 2.1 Reference Manual is referenced as a resource in a number of Washington Sustainable Schools Protocol Credits. See the USGBC's web site at http://www.usgbc.org for more information on how to join the organization and obtain the referenced materials.

Priorities

Sustainability and high performance are broad topics. The Washington Sustainable Schools Protocol span a wide variety of areas, from site planning and energy use, to material specifications and indoor environmental quality. The prerequisites in the Protocol are typically design issues required by state law. However, the design must move beyond the prerequisites to ensure that the Washington Sustainable School is healthy, operates efficiently, increases student productivity, and reduces environmental impact. Listed below are the design areas and credits that are recommended by Washington Sustainable Schools to maximize the performance of the school.

- **Daylighting.** Quality daylighting designs have been proven to improve student productivity. When integrated properly with the electric lighting system, daylighting saves significant amounts of energy.
  IEQ Credit 1: Daylighting in Classrooms (1-3 points).
- **Energy Efficiency.** Energy efficiency should be a cornerstone of a Washington Sustainable School to reduce operational expenses, conserve natural resources, and reduce local and global pollution.
  Energy Credit 1: Superior Energy Performance (4-12 points).
  Energy Credit 2: HVAC and Operable Windows (1 point).
- **Indoor Environmental Quality.** Schools must protect student health, and good indoor air quality is essential for healthy schools. Because indoor air quality can be impacted both by design and construction choices, each of the credits below should be addressed to achieve good indoor air quality.
  IEQ Credit 3: Low-Emitting Materials (1-5 points).
  IEQ Credit 4: Pollutant Source Control (1-3 points).
  IEQ Credit 5: Construction IAQ Management Plan (1-2 points).
- **Commissioning and Training.** All schools should be commissioned to ensure that the design meets the expectations of the district, and that the school is built as it was designed. Modern schools are complex buildings. Commissioning ensures that all building systems are working properly, and that the school staff knows how to operate

and maintain them.
Energy Credit 4: Commissioning (1-2 points).

- **Acoustics.** If not controlled to appropriate levels, noise from loud ventilation systems, outdoor sources, and neighboring rooms can significantly impede communication between teachers and students. Young learners, students with hearing difficulties, and those learning English as a second language are particularly vulnerable. Classrooms should be designed to be accessible for all students.
  IEQ Credit 6: Improved Acoustical Performance (1-2 points).
- **Sustainable Materials.** Hidden within all materials are the resources, energy, chemicals, and environmental damage involved in their production. More sustainable alternatives exist and should be used as much as possible.
  Materials Credit 4: Recycled Content (1-2 points).
  Materials Credit 5: Rapidly Renewable Materials (1 point).
  Materials Credit 6: Certified Wood (1-3 points).
- **Site Responsive.** As much as possible, a high performance school will avoid degrading natural ecosystems, while seeking to incorporate natural conditions to enhance the building's performance. In addition, the school design will encourage non-polluting transportation alternatives.
  Site Credit 1: Sustainable Site Selection (1-8 points).
  Site Credit 2: Transportation (1-3 points).
  Site Credit 3: Permanent Stormwater Management (1-2 points).
- **Waste Reduction.** It is now possible to recycle, compost, or salvage a majority of construction and demolition waste instead of disposing it in landfills. Cost savings are available with effective construction waste management. When reuse is possible (of either resources or the building itself), this can represent avoided costs for new materials, disposal as well as avoided environmental impacts of producing new building materials.
  Materials Credit 1: Site Waste Management (1-2 points).
- **Water Efficiency.** Basic efficiency measures can reduce a school's water use by 30% or more. These reductions help the local environment, while reducing a school's operating expenses. While cost savings may be modest now, these savings will likely rise over time due to climate changes and the rising importance of water levels.
  Water Credit 1: Reduce Potable Water for Landscaping (1-3 points).
  Water Credit 2: Water Use Reduction (1-3 points).

There are up to four points available for district-wide support of high performance policy to encourage system change. Washington Sustainable Schools also encourages innovation at the project level and provides up to four points for innovations that would enhance a high performance school. In particular, Washington Sustainable Schools supports the development of a resolution or policy integrating high performance standards into district educational specifications and building programs, as well as the development of student learning opportunities highlighting environmentally sensitive aspects of building and site design. *Please note that while "extra credits" are encouraged, no more than four points can be applied to the 38 points minimum required to qualify as a Washington Sustainable School.*

PROTOCOL OVERVIEW

Category	Group	Credit Name		Points	Page
Site **16 points**	Site Selection	Prereq 1	Code Compliance	R	4
		Credit 1	Sustainable Site Selection	1-8	5
	Transportation	Credit 2	Transportation	1-3	7
	Stormwater Management	Prereq 2	Temporary Sedimentation and Erosion Control	R	8
		Credit 3	Permanent Stormwater Management	1-2	9
	Outdoor Surfaces	Credit 4	Design to Reduce Heat Islands	1-2	11
	Outdoor Lighting	Credit 5	Light Pollution Reduction	1	12
Water **6 points**	Outdoor Systems	Prereq 1	Create Water Use Budget	R	13
		Credit 1	Reduce Potable Water for Landscaping	1-3	15
	Indoor Systems	Credit 2	Water Use Reduction	1-3	17
Materials **17 points**	Waste Reduction and Efficient Material Use	Prereq 1	Storage and Collection of Recyclables	R	20
		Credit 1	Site Waste Management	1-2	21
		Credit 2	Building Reuse	1-3	22
		Credit 3	Resource Reuse	1-3	23
	Sustainable Materials	Credit 4	Recycled Content	1-2	24
		Credit 5	Rapidly Renewable Materials	1	26
		Credit 6	Certified Wood	1-3	27
		Credit 7	Eliminate Ozone-Depleting Substances	1	28
		Credit 8	Regional/Local Materials	1-2	29
Energy **20 points**	Energy Efficiency	Prereq 1	Minimum Energy Performance	R	30
		Credit 1	Superior Energy Performance	4-12	31
		Credit 2	HVAC and Operable Windows	1	36
	Alternative Energy Sources	Credit 3	Renewable Energy and Distributed Generation	1-4	37
	Commissioning and Verification	Prereq 2	System Testing and Training	R	39
		Credit 4	Commissioning	1-2	41
		Credit 5	Energy Management Systems	1	43
Indoor Environmental Quality **21 points**	Daylighting	Prereq1	Daylighting in Classrooms	R-3	45
		Credit 1	Daylighting in Classrooms	1-3	46
	Lighting Quality	Credit 2	Classroom/Library Lighting	1	47
	Indoor Air Quality	Prereq 2	Minimum Requirements	R	48
		Credit 3	Low-Emitting Materials (Interior Use)	1-5	50
		Credit 4	Pollutant Source Control	1-3	52
		Credit 5	Construction IAQ Management Plan	1-2	53
	Acoustics	Prereq 3	Minimum Acoustic Performance	R	54
		Credit 6	Improved Acoustical Performance	1-2	55
	Thermal Comfort	Prereq 4	*ASHRAE 55* Code Compliance	R	56
		Credit 7	Controllability of Systems	1-2	57
		Credit 8	Natural Cooling	3	57
Extra Credit **8 points**	District Level	Credit 1	District Level Innovation	1-3	58
	Project Level	Credit 2	Project Level Innovation	1-3	60
			Total Points	**88**	

Minimum required for Washington Sustainable School (4 points must be in Energy category and no more than 4 points from the Extra Credit category) **38**

WORKING
DRAFT

SITE

Site Selection

Purpose: Choose sites that protect students and staff from outdoor pollution and minimally impact the environment. Channel development to centrally located areas, with existing infrastructure, to protect greenfields, minimize transportation requirements, and preserve habitat and natural resources.

Site Prerequisite 1: Code Compliance

Required	P1.1. School Facilities Compliance. Comply with all siting and environmental impact study requirements of the most current edition of the School Facilities Manual, issued by the Washington State Office of the Superintendent of Public Instruction.

Resources

Health and Safety Guide for K-12 Schools in Washington. Jointly published by the Washington State Office of the Superintendent of Public Instruction and the Department of Health, available online at http://www.k12.wa.us/schfacilities/healthsafetyguide.aspx.

School Facilities Manual, Washington State Office of the Superintendent of Public Instruction, available online at http://www.k12.wa.us/SchFacilities/pubdocs/SFMANUAL/intro.pdf.

Site Credit 1: Sustainable Site Selection

1 point	1.1. Do not develop buildings on sites that meet any of the following criteria: ▪ Important farmland as defined by the US Department of Agriculture. ▪ Land whose elevation is lower than five feet above the elevation of the 100-year flood as defined by FEMA. ▪ Land that provides habitat for any species on the federal or state threatened or endangered list. ▪ Within 100 feet of any wetland as defined by 40 CFR, Parts 230-233 and Part 22, ***OR*** as defined by local or state rule or law, whichever is more stringent.
1 point	1.2. Do not build on greenfields. Greenfields are defined as those sites that are undeveloped except for agricultural use.
1 point	1.3. Location. Locate sites where at least 50% of students live within the following distances from the school: ▪ Elementary Schools: within one mile. ▪ Middle Schools: within two miles. ▪ Junior High School: within three miles. ▪ High Schools: within four miles.
1-2 points	1.4. Joint Use of Facilities. Make available portion(s) of the school building for either shared or dedicated use by community and other appropriate organizations. One point if the space is "shared" use. An additional point (total of two points) if the space is "dedicated" for use by the community and other appropriate organizations.
1 point	1.5. Joint Use of Parks. Share park or recreation space with local park boards or other organizations.
1-2 point	1.6. Minimize Footprint. Design the school with a Floor Area Ratio (FAR) of at least 1.4. One point if the FAR is at least 1.4. An additional point (total of two points) if the FAR is at least 1.6. (The FAR is the building's total square footage divided by its footprint.)

The site is a crucial element in determining the overall sustainability of the school design. Sites are sometimes purchased years in advance, and some of these credits may be out of the control of the districts and/or designers at the time the school is being built. In addition, some of these credits may be more difficult for rural/suburban areas where distances between home and school can be significant. However, districts that are considering multiple sites can substantially lower the environmental impact of the school by choosing centrally located sites, sharing parks or facilities with community organizations, preserving open space, and protecting environmentally sensitive areas.

Credit 1.1. Environmentally sensitive or important spaces should be avoided.

CFR: The Code of Federal Regulations (CFR) is a publication of the United States Federal Government that lists rules authorized by the executive departments and agencies.

Important Soils: The Natural Resources Conservation Services (NRCS) division of the United States Department of Agriculture maintains the definitions and soil surveys that designate areas as "important farmland." Lists of Prime and Statewide Important Farmland Soils are maintained for each soil survey area and may be obtained from the Field Office Technical Guide (FOTG) located in each NRCS field office. County and state offices of the NRCS keep maps showing the status of maps within their jurisdiction. County offices can be located at http://offices.usda.gov/scripts/ndISAPI.dll/oip_public/USA_map.

100-Year Flood Plains: Washington is in FEMA's Region X (http://www.fema.gov/regions/x/index.shtm). To request a map showing the 100-year flood elevations (called Flood Insurance Rate Maps, or FIRM Maps) contact a Region X Map Specialist

toll-free by phone at 1-877-FEMA MAP, or by email at bakermail@mbakercorp.com. Unofficial maps by ESRI are available online at http://www.geographynetwork.com.

Wetlands: The term wetlands is defined in Title 40 as "those areas that are inundated or saturated by surface or ground water at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions. Wetlands generally include swamps, marshes, bogs and similar areas." [Source: CFR: Title 40. 330.4]. The US Army Corps of Engineers, the Washington State Department of Ecology, Fish and Wildlife and the Department of Natural Resources all work in parallel to regulate waterways (which include wetlands) in Washington. Federally, the primary laws are the Clean Water Act and the Coastal Zone Management Act. The main state laws are the State Water Pollution Control Act, the Growth Management Act, and the Shoreline Management Act. (Resource: How Ecology Regulates Wetlands, Washington State Department of Ecology, Publication 97-112, April 1998.)

Credit 1.2. When choosing between multiple sites, use previously developed sites instead of greenfields.

Greenfields are semi-rural or rural properties that are undeveloped except for agricultural use, and considered as a site for expanding urban development.

Urban redevelopment reduces environmental impacts by utilizing established infrastructure and preserving undeveloped lands. If the site already contains a building, additional points may be earned with Materials Credit 2: Building Reuse.

Credit 1.3. Over the lifetime of the building, school districts and families invest significant time, energy, and money transporting students to and from school. Cars driven by parents, guardians, or the students themselves are the largest resource users and sources of transportation-related pollution. Centrally located sites allow more students to walk or bike to school, while reducing the distance cars must travel.

For rural districts, this credit may be difficult to achieve since distances between home and school are much larger.

To earn this point, calculations must be based on the estimated school population when the school opens. Additional transportation-related points are covered in Site Credit 2: Transportation, as well as an innovation credit transportation options at the district and project level (see Extra Credits 1.2 and 2.2).

Credits 1.4 and 1.5. Joint use of facilities and parks is a growing trend for schools across the country. Schools are being integrated with a variety of facilities, from laundromats and coffee shops to police stations and park districts. These credits apply to both existing and newly created parks. Joint use can have significant benefits, including increased campus security, improved community integration, and reduced site acquisition and construction costs. School districts should have formal agreements for all building users in place before occupancy.

Credit 1.6. Building multi-story schools reduces the area of the site disturbed by construction. A FAR of 1.4 requires 40% of a school's square footage to be on a second floor. A FAR of 1.6 requires 60% of the schools square footage to be on the second floor.

Resources
LEED Reference Guide: Site Credit 1: Site Selection and Site Credit 5.2: Reduce Development Footprint.

Transportation

Purpose: Reduce dependence on fossil fuels, and reduce pollution and land development impacts from automobile use.

Site Credit 2: Transportation

1 point	2.1. Public Transportation. In urban areas, locate building within 1/4 mile of a commuter rail, light rail or subway station, or within 1/8 mile of one or more bus lines. In rural and suburban areas, with limited or non-existent rail/bus service, provide busing to the school.
1 point	2.2. Bicycles. Provide bike lanes or sidewalks that extend to the end of the property, AND provide suitable means for securing bicycles for at least 5% of building occupants in an elementary or middle school, and 3% of building occupants in a high school.
1 point	2.3. Minimize Parking. Provide preferred parking totaling 5% of staff and student spaces for carpools or vanpools and alternative fuel vehicles, and size parking capacity not to exceed: ▪ Junior and High Schools: 2.25 spaces per classroom plus parking for 20% of students; ▪ Elementary and Middle Schools: three spaces per classroom; ***OR***, add no new parking for rehabilitation projects and provide preferred parking totaling 5% of staff and student spaces for carpools, vanpools, and alternative fuel vehicles.

The energy-use and pollution associated with transportation often dwarfs the total lifetime energy used by the school itself. Locating the site close to public transportation, creating bike facilities and safe access, and offering bus service, all reduce the automobile-related pollution. An innovation point can be earned for projects that undertake a substantial transportation options planning process (see Extra Credit 2.1).

Credit 2.1. When available, public transportation can provide significant reductions in energy impacts. Some school districts offer reduced or subsidized fares for students and staff using public transportation. If sufficient capacity exists, schools can use public transportation to replace district provided bus service.

In rural and suburban areas with limited or non-existent rail/bus service, provide busing to the school.

Notes: Schools near high traffic areas must ensure safe student access. In addition, transportation-related pollution (and the site's air quality) must be considered when investigating the project's potential for natural ventilation.

Credit 2.2. Bicycles are a popular and pollution-free form of transportation. To protect pedestrians and bicyclists, bike lanes and sidewalks must extend to the end of the school property. Work with local planners to develop safe pedestrian and bike connections to likely destinations, e.g., public transportation and town centers.

Credit 2.3. Excess parking spaces encourage increased automobile use, contribute to urban heat island effects, and can increase pollution from stormwater runoff. Design parking so as not to exceed listed amounts and include clearly marked, preferred parking areas for carpools and alternative fuel vehicles. Stand-alone alternative fuel vehicles such as electric hybrid vehicles use less fuel per mile traveled than conventional gasoline vehicles, and reduce the pollution associated with automobile use.

Resources
CHPS Best Practices Manual, Volume II: Guideline SP3: Safe and Energy Efficient Transportation.

LEED™ Reference Guide: Site Credit 4: Alternative Transportation.

Stormwater Management

Purpose: Manage stormwater during and after construction to control erosion and runoff, reducing the negative impacts on water and air quality.

Site Prerequisite 2: Temporary Sedimentation and Erosion Control

Required	P2.1. Design to a site sediment and erosion control plan that follows the best management practices outlined by the Washington State Department of Ecology's Stormwater Management Manuals (Ecology's Stormwater Management Manual for Western Washington: Volume II -- Construction Stormwater Pollution Prevention, and the Final Draft Stormwater Management Manual for Eastern Washington), or the local ordinance, whichever is more stringent. The plan shall meet the following objectives: ▪ Prevent loss of soil during construction by storm water runoff and/or wind erosion, including protecting topsoil by stockpiling for reuse. ▪ Prevent sedimentation of storm sewer or receiving streams and/or air pollution with dust and particulate matter.

Construction site stormwater runoff is regulated at the state and local levels. Check with your local agencies for local permit requirements.

A variety of best practices address this prerequisite, including:

Runoff Control	**Minimize clearing:** land grading, permanent diversions, preserving natural vegetation. **Stabilize drainage ways:** check dams, filter berms, grass-lined channel, and riprap.
Erosion Control	**Stabilize exposed soils:** chemical stabilization, mulching, permanent seeding, sodding, soil roughening. **Protect steep slopes:** geotextiles, gradient terraces, soil retention, temporary slope drain. **Protect waterways:** temporary stream crossings, vegetated buffer. **Phase construction:** construction sequencing, dust control.
Sediment Control	**Install perimeter controls:** temporary diversion dikes, wind fences and sand fences, brush barrier, silt fence. **Install sediment-trapping devices:** sediment basins and rock dams, sediment filters and sediment chambers, sediment trap. **Storm drain inlet protection:** sandbags, concrete blocks, gravel barriers.

Resources

"Compost Filter Berms and Blankets Take on the Silt Fence", *Biocycle,* January 2001.

CHPS Best Practices Manual, Volume II: Guideline GC4: Site Protection During Construction.

EPA On-line Best Practices Information: http://www.tetratech-test.com/bmpmanual/htmfolder/menu.htm.

EPA Storm Water Management for Construction Activities, EPA Document No. EPA-833-R-92-001.

Innovative Uses of Compost: Erosion Control, Turf Remediation, and Landscaping. EPA Document No. EPA530-F-97-043. http://www.epa.gov/epaoswer/non-hw/compost/erosion.pdf.

LEED™ Reference Guide: Site Prerequisite 1 Erosion and Sedimentation Control.

Washington State Department of Ecology's Final Draft Stormwater Management Manual for Eastern Washington, available online at: http://www.ecy.wa.gov/programs/wq/stormwater/eastern_manual/workshops.html.

Washington State Department of Ecology's Stormwater Management Manual for Western Washington: Volume II -- Construction Stormwater Pollution Prevention, September 2001, available online at http://www.ecy.wa.gov/biblio/9912.html.

Site Credit 3: Permanent Stormwater Management

1 point	3.1. Promote onsite infiltration. No net increase in the rate or quantity of stormwater runoff from existing to developed conditions. ***OR*** if existing imperviousness is greater than 50%, implement a stormwater management plan that results in a 25% decrease in the rate and quantity of stormwater runoff.
1 point	3.2. Treat runoff or effectively reduce it to zero for average conditions. Install treatment systems designed to remove 80% of the average annual post-development total suspended solids (TSS), and 40% of the average annual post-development total phosphorous (TP), by implementing best management practices outlined in Washington State's Department of Ecology's Stormwater Management Manual's for either Western or Eastern Washington or in EPA's Guidance Specifying Management Measures for Sources of Nonpoint Pollution in Coastal Waters (EPA 840-B-92- 002 1/93). ***OR***, reduce stormwater runoff to zero at 10-year storm event flow level.

Stormwater runoff is rainwater that flows over surfaces on the site and enters either the sewage system or receiving waters. Stormwater carries sediment and pollutants from the site into the sewage system and/or local bodies of water. In addition, the cumulative runoff throughout the local area requires significant investments in municipal infrastructure to handle peak runoff loads.

Onsite infiltration reduces the rate and quantity of stormwater runoff. Stormwater treatment reduces the contaminants leaving the site.

Stormwater management is regulated by the Department of Ecology.

Credit 3.1. Reducing the amount of runoff is the most effective way to minimize its negative impacts.

Low impact development (LID) is an integrated approach to site development and storm water management that emphasizes strategies to mimic natural site hydrology rather than using conventional "pipe and pond" techniques. In practice, a site will use multiple LID strategies that are uniformly distributed across the site. LID strategies include:

- Maximize on-site stormwater infiltration by directing site water through use of bioretention/rain gardens and infiltration facilities.
- Maximize retention of stormwater in soil by protecting existing soils on site that have high infiltration, and by using bioretention/rain gardens.
- Reduce impervious surfaces while increasing pervious and vegetated areas.
- Capture rainwater from impervious areas of the building for irrigation or reuse within the building.
- Install green/vegetated roofs.
- Reduce building footprint.
- Decrease street widths.

A recent demonstration project in the City of Seattle has used a combination of LID strategies for a residential street. Early results for the first year indicate that the new design has reduced runoff by 98%, by reducing pavement, increasing infiltration, and using natural areas for surface drainage.

Credit 3.2. Total suspended solids (TSS) are particles that are too small or light to be removed from stormwater by gravity settling alone, and must typically be removed with filtration methods. Total phosphorous (TP) consists of organically bound phosphates, poly-phosphates, and orthophosphates in stormwater, and usually originate from fertilizers. An alternative to measuring TSS and TP for this credit is to design the system to reduce storm water to zero at 10-year storm event flow level.

Common treatment systems include infiltration basins and trenches, porous pavement, vegetated filter strips, grassy swales, filtration basins, and constructed wetlands.

Bioswales or Grassy Swales: A technology that uses plants and soil and/or compost to retain and cleanse runoff from a site, roadway, or other source.

Biofiltration or Vegetated Filter Strips: Vegetated treatment systems that remove pollutants by means of sedimentation, filtration, soil sorption, and/or plant uptake. They are typically configured as swales or flat filter strips.

Bioretention/Rain Garden: A planted system with a soil profile that is designed for both water quality and stormwater retention.

Constructed Wetlands: An area on a building site used as stormwater detention storage facilities that are designed to simulate naturally occurring wetlands (also called swamps, bogs, fens, marshes, and estuaries). A natural wetland has plants well adapted to regular saturation by surface or ground water.

Green/Vegetated Roofs: Contained green space on, or integrated with, a building roof. Green roofs maintain living plants in a growing medium on top of a membrane and drainage system. Green roofs have the capacity to reduce stormwater runoff from a site, they modulate temperatures in and around the building, have thermal insulating properties, can provide habitat for wildlife and open space for humans, and other benefits.

Impervious Surface: A surface that sheds, rather than infiltrates, the precipitation falling on it. Impervious surfaces can lead to excessive stormwater runoff and limit the amount of stormwater that remains onsite or recharges local aquifers.

Infiltration: The penetration of water through the ground surface into sub-surfaces and/or underlying soil.

Pervious Surface: A surface that allows water to pass through the top layer to percolate into the soil below.

Porous Pavement: Paving surfaces designed to allow stormwater infiltration and reduce runoff.

Resources:
EPA On-line Best Practices information, http://www.tetratech-test.com/bmpmanual/htmfolder/menu.htm.

LEED™ Reference Guide: Site Credit 6: Stormwater Management.

Puget Sound and Pacific Northwest Low Impact Development Resources, link through the Low Impact Development Center, http://www.lowimpactdevelopment.org/links.htm - pugetsound.

Seattle's pilot Street Edge Alternatives (SEA Street) information, http://www.cityofseattle.net/util/seastreets/default.htm.

Washington State Department of Ecology's Stormwater Management Manual for Eastern Washington - DRAFT FINAL - Chapters 5 and 6, June 2003, available online at http://www.ecy.wa.gov/biblio/0310038B.html.

Washington State Department of Ecology's Stormwater Management Manual for Western Washington: Volume V -- Runoff Treatment BMPs, September 2001, available online at http://www.ecy.wa.gov/biblio/9915.html.

Outdoor Surfaces

Purpose: Reduce heat islands to minimize impact on microclimate, and human and wildlife habitat.

Site Credit 4: Landscape and Exterior Design to Reduce Heat Islands

1 point	4.1. Landscaping Issues. Provide shade (within five years) on at least 30% of non-roof, impervious surfaces on the site, including parking lots, walkways, plazas, etc. ***OR*** use light-colored/ high-albedo materials (reflectance of at least 0.3) for 30% of the site's non-roof, impervious surfaces. ***OR*** use an open-grid pavement system (net impervious area of LESS than 50%) for a minimum of 50% of the parking lot area.
1 point	4.2. Cool Roofs. On low-sloped roofs (2:12 or less) in climate zone 5 install an ENERGY STAR® labeled Cool Roof with an emmissivity of at least 0.9 for a minimum of 75% of the roof surface. ***OR*** install a "green" (vegetated) roof for at least 50% of the roof area.

Credit 4.1. Employ design strategies, materials, and landscaping designs that reduce heat absorption of exterior materials. Note albedo/reflectance requirements in the drawings and specifications. Provide shade using native or climate-tolerant trees and large shrubs, vegetated trellises, or other exterior structures supporting vegetation. Substitute vegetated surfaces for hard surfaces. Explore elimination of blacktop and the use of new coatings and integral colorants for asphalt to achieve light colored surfaces.

Credit 4.2. Cool roofs can significantly reduce school cooling loads and urban heat island effects by reflecting the sun's energy, instead of absorbing, retaining, and radiating it into the occupied spaces below. With cool roofs, both the reflectivity and emissivity are important. Solar reflectance is the ratio of the electromagnetic energy reflected by a surface to the total amount incident upon it. A solar reflectance of 0.0 means all the solar energy hitting the surface is absorbed and none is reflected. Emissivity is the ability of a material to shed infrared radiation. In other words, surfaces with high emissivities lower their surface temperatures by shedding infrared radiation. Bare metals, for example, have low emissivities and stay hotter for longer periods than materials with high emissivity. The EPA's ENERGY STAR® program includes a database of high-reflectance roofing materials. To ensure high emmissivity, do not use bare metal roofing products.

Resources

Advanced Building Guidelines Energy Benchmark (E-Benchmark): Prescriptive Criteria 2.3: C. Cool Roofs and Ecoroofs. http://www.newbuildings.org/abg.htm.

CHPS Best Practices Manual, Volume II: SP2: Landscaping to Provide Shade to Buildings and Paved Areas; SP5: Impervious Surfaces; IN3: Cool Roofs.

LEED™ Reference Guide: Credit 7: Landscape and Exterior Design to Reduce Heat Islands.

Outdoor Lighting

Purpose: Eliminate light trespass from the building site, improve night sky access, and reduce development impact on nocturnal environments.

Site Credit 5: Light Pollution Reduction

1 point	5.1. Do not exceed Illuminating Engineering Society of North America (IESNA) footcandle level requirements as stated in the *IESNA RP-33 Recommended Practice for Exterior Environmental Lighting* or applicable sections of the *IESNA Lighting Handbook, Current Edition;* ***AND*** design interior and exterior lighting (excluding sports fields) such that zero direct-beam illumination leaves the building site.

Consult *IESNA Recommended Practice Manual*: Lighting for Exterior Environments for CIE zone and pre- and post-curfew hour descriptions and associated ambient lighting level requirements. Ambient lighting for pre-curfew hours for CIE zones range between 0.01 footcandles for areas with dark landscapes such as parks, rural, and residential areas, and 1.5 footcandles for areas with high ambient brightness such as urban areas with high levels of nighttime activity. Design site lighting and select lighting styles and technologies to have minimal impact off-site and minimal contribution to sky glow. Minimize lighting of architectural and landscape features.

Resources
CHPS Best Practices Manual, Volume II: EL11: Outdoor Lighting.

The International Dark Sky Association: http://www.darksky.org/ida/index.html. The Washington Chapter (http://www.skykeepers.org/) maintains state-focused information. The *International Dark Sky Association Lighting Handbook* is available on line at http://www.nofs.navy.mil/about_NOFS/staff/cbl/LC_Handbook.html.

LEED™ Reference Guide: Site Credit 8: Light Pollution Reduction.

WATER

Outdoor Systems

Purpose: Reduce water use for landscaping and ornamentation.

Water Prerequisite 1: Create Water Use Budget

Required	P1.1. Develop and design to a landscape and ornamental water use budget that conforms to local water efficient landscape ordinances. If no local ordinance exists, use the landscape and ornamental budget ordinance developed by the City of Bellevue.

To comply with this credit, calculate the estimated water use (EWU) landscape and the Maximum Applied Water Allowance (MAWA) for the landscape. The EWU must not exceed the MAWA. Once a water budget is established, design the landscape to meet established budget baselines.

MAWA is the *most* irrigation water allowed for the landscape on an annual basis. It takes into account local conditions and the size of the landscape area and is calculated as follows:

MAWA = (ET) (LA) (0.8) (0.62)

Where:

MAWA = Maximum Applied Water Allowance (gallons per year).

ET = Evapotranspiration Rate for the site (inches per year). ET is the amount of water that transpires from plants and evaporates from adjacent soil surfaces. ET takes into account local soil conditions and the local, average annual net rainfall (total rainfall minus runoff).

LA = Landscaped Area (ft^2).

0.8 = ET Adjustment Factor. This factor adjusts for plant factors and irrigation efficiency.

0.62 = Conversion Factor. This converts the maximum applied water allowance to units of gallons per year.

To estimate total annual irrigation water use, calculate the EWU for each plant zone according to the equation below, then sum up the EWUs for all zones in the landscaped area:

EWU = (ET) (PF) (LA) (0.62)/IE

Where:

EWU = Estimated Water Use (gallons per year).

ET = Evapotranspiration Rate for the site (inches per year).

PF = Plant Factor for the zone (For low water use plants PF = 0 to 0.3, medium water use plants, PF = 0.4 to 0.6, high water use plants, PF = 0.7 to 1; all irrigated turfgrass, PF = 0.8 to 1).

LA = Landscape Area (ft^2) for the zone.

0.62 = Conversion Factor (to gallons per ft^2). This converts EWU to units of gallons per year.

IE = Irrigation Efficiency (0.625 for conventional overhead spray systems, 0.925 for low volume or drip irrigation systems).

Sports or activity fields are considered recreational areas and may require water in addition to the MAWA. A statement should be included with the landscape design plan, designating recreational areas to be used for such purposes and specifying any needed amount of additional water above the MAWA.

Resources
City of Bellevue, Washington landscape budget ordinance example: Municipal Code Section 24.02.205 http://www.cityofbellevue.org and Water Engineering Standards, section W3-12, http://www.cityofbellevue.org/page.asp?view=4797.

Good sources for site-specific data to calculate the net evapotranspiration:

- Golf course weather stations.
- Local weather stations.
- Parks departments.
- Washington State University, the Agricultural Extension Office.
- USDA Natural Resources Conservation Service.

Water Credit 1: Reduce Potable Water for Landscaping

1 point	1.1. Reduce potable and river or groundwater irrigation district water consumption for irrigation by 50% over landscape budget baselines with the use of water-efficient native (or adapted) climate-tolerant plantings, high-efficiency irrigation technologies, or using captured rain or municipally provided reclaimed water.
1 point	1.2. Reduce potable and river or groundwater irrigation district water for site irrigation by additional 50% (a total of 100% reduction in water use) from water budget baselines; ***OR*** do not install permanent landscape irrigation systems.
1 point	1.3. Irrigation Commissioning. Create an irrigation commissioning plan (also known as a water audit plan) followed by installation review during construction, performance testing after installation, and documentation for ongoing operations and maintenance.

Water resources are a growing concern in Washington, even in the rain-drenched west, as expanding populations and multiple uses increase the demand for limited supplies. Precipitation patterns in much of Washington make it difficult to store enough rainwater for irrigation through the dry summers, though school grounds may not require irrigation during summer months. High efficiency irrigation technologies such as micro irrigation, moisture sensors, and weather-data based controllers save water by reducing evaporation losses or operating only when needed. However, these systems require careful design, as well as additional operations and maintenance requirements. For example some drip irrigation systems may be more vulnerable to vandalism, moisture sensors must be carefully placed to represent the soil type and exposure of individual irrigation zones accurately, and timers and controls, if not weather-data based, need to be adjusted seasonally.

Credit 1.3. An irrigation commissioning plan shall be prepared by the installing contractor, landscape architect/designer of record, or school district's agent during design, followed by:

- Review of installation during construction, with record of deficiencies found and corrected, plus
- Performance testing and documentation of results (as compared to specified performance) at least once during the first year of installation, and
- Creation and distribution of site-specific documentation for ongoing operation and maintenance information including recommended irrigation schedule and maintenance schedules.

Acceptance testing shall be performed on the following, if applicable:

- Irrigation pipes and connections.
- Irrigation heads and coverage.
- Back-flow devices.
- Coverage of irrigation.
- Automatic sensors, timers and other controls.

For equipment not listed above, the design team shall provide acceptable test results and the contractor shall certify that the tests were performed and the equipment performs as specified.

Coverage of irrigation should be tested keeping in mind the precipitation requirements for each plant zone. For example, a zone with drought tolerant plants may need *less than* one inch of water per week; other zones may need *more than* one inch of water per week.

The landscape irrigation requirements should be reflected in the water use budget created for Water Prerequisite 1.

Resources
CHPS Best Practices Manual, Volume II: Guideline SP6: Drought Tolerant and Pest-Resistant Plants, Guideline SP10: Water-Efficient Irrigation Systems; Guideline SP12: Reclaimed Water for Irrigation.

LEED™ Reference Manual: Water Credit 1: Water Efficient Landscaping.

Local water utility staff, water efficient landscape consultants, Certified Irrigation Designers (http://www.irrigation.org/), and Master Gardeners would also be good resources for helping achieve this credit.

Washington Native Plant Society, http://www.wnps.org/.

Indoor Systems

Purpose: Maximize water efficiency within buildings to reduce the burden on municipal water supply and wastewater systems.

Water Credit 2: Water Use Reduction

1 point	2.1. Reduce the use of municipally provided potable water for building sewage conveyance by a minimum of 45% beyond the baseline calculated for the building (not including irrigation) after meeting the Energy Policy Act of 1992's fixture performance requirements.
1 point	2.2. Employ strategies that, in aggregate, reduce potable water use by at least 20% beyond the baseline calculated for the building (not including irrigation) after meeting the Energy Policy Act of 1992's fixture performance requirements.
1 point	2.3. Reduce the potable water use by an additional 10% (a total reduction of at least 30%) beyond the baseline.

Well-designed, water efficient systems can earn one point by reducing the amount of potable water used for sewage conveyance (Credit 2.1), and up to two points by reducing the overall amount of potable water used in the schools (Credits 2.2 and 2.3). For all credits, code must be complied with.

Develop a water use baseline including all water consuming fixtures, equipment, and seasonal conditions according to methodology outlined below. Specify water conserving plumbing fixtures that exceed the Energy Policy Act of 1992's fixture requirements in combination with ultra high efficiency or dry fixture and control technologies. Specify high water efficiency equipment and appliances (dishwashers, laundry, cooling towers).

Because water-efficient devices can vary in quality and performance, specify only durable, high performance fixtures.

Design and maintenance issues will be different with low flow toilets compared to toilets with higher flow.

Credit 2.1. Use water-efficient fixtures and/or municipally supplied reclaimed water to reduce the amount of potable water used for sewage conveyance. Only those fixtures that convey sewage, such as toilets and urinals, are included in this credit. The use of reclaimed water for flushing toilets and urinals automatically qualifies the project for this point because it results in a 100% reduction in the use of municipally provided potable water for this purpose.

Calculate and compare the baseline and design water uses as described below. To qualify for the credit, the calculated design water use must be at least 45% less than the baseline.

EXAMPLE: A water-efficient design for a 1,000-student school.

Baseline Water Use. For baseline calculations, assume flow rates outlined by the Energy Policy Act of 1992's fixture performance requirements:

Fixture	EPA Requirements
Toilets	1.6 gal/flush
Urinals	1.0 gal/flush
Showerheads	2.5 gal/min
Faucets	2.5 gal/min
Replacement Aerators	2.5 gal/min
Metering Faucets	0.25 gal/cy

To calculate the baseline water use:

1. Calculate Daily Water Use per fixture based on occupancy and estimated frequency of use:

   Daily Water Use = (Flow-rate) (Duration) (Occupants) (Daily Uses)

2. Sum Daily Water Volumes for each fixture to find Total Daily Volume.

3. Multiply the Total Daily Volume by the number of school days for Total Annual Volume.

In this example:

Fixture Type	Flow-rate	Occupants	Daily uses	Water use (gal)
Conventional Toilet (male)	1.6 gal/flush	500	1	800
Conventional Urinal (male)	1.0 gal/flush	500	2	1000
Conventional Toilet (female)	1.6 gal/flush	500	3	2400
			Total Daily Volume	**4200**
			Number of School Days	**180**
			Baseline Total Annual Volume	**756,000**

Design Water Use (Efficient Fixtures). Now assume the design case is based on the use of extra-efficient fixtures. In this case:

Fixture Type	Flow-rate	Occupants	Daily Uses	Water Use (gal)
Low Flow Toilet (male)	1.1 gal/flush	500	1	550
Waterless Urinal (male)	0.0 gal/flush	500	2	0
Low Flow Toilet (female)	1.1 gal/flush	500	3	1650
			Total Daily Volume	**2200**
			Number of School Days	**180**
			Design Total Annual Volume	**396,000**

Comparing the two calculations, the water-efficient fixtures reduced potable water use for sewage conveyance by:

% Savings = 1 – (Design Total Annual Volume / Baseline Total Annual Volume)

= 1 – (396,000/756, 0000) = 0.476 = 48%

Therefore, this design would earn one point because potable water used for sewage conveyance has been reduced by more than 45% (48%) through the use of extra-efficient toilets and urinals.

Credits 2.2 and 2.3. These credits award reductions in total water use; therefore all water-consuming fixtures uses are included in the calculations. To quantify water use reductions, calculate and compare baseline and design water uses. List each water-using appliance or fixture, the amount of daily uses, number of occupants, and calculate the total water use. Any reclaimed water used for sewage conveyance is subtracted from the total amount of water used. A water-efficient design for the school shown in the previous example is shown below.

Fixture Type	Flow-rate	Duration	Automatic Controls	Occupants	Daily uses	Water use
Low Flow Toilet (male)	1.1 gal/flush	1 flush	-	500	1	550
Waterless Urinal (male)	0.0 gal/flush	1 flush	-	500	2	0
Low Flow Toilet (female)	1.1 gal/flush	1 flush	-	500	3	1650
Bathroom Sink	2.5 gal/min	0.25 min	20% saved	1000	3	1500
Low Flow Shower	1.8 gal/min	5 min	-	100	1	900
Low Flow Kitchen Sink	1.8 gal/min	45 min	-	2	2	324
Efficient Washing Machine	20 gal/load	1 load	-	-	10	200
					Total Daily Volume	**5124**
					Number of -School Days	**180**
					Subtotal	**922,320**
					Minus Amount of Reclaimed Water Used	**(396,000)**
					Design Total Annual Volume	**526,320**

For the baseline calculation, create a similar spreadsheet but change only the type of fixture and its associated design details. The baseline calculation for this example would therefore be:

Fixture Type	Flow-rate	Duration	Automatic Controls	Occupants	Daily uses	Water use
Conventional Toilet (male)	1.6 gal/flush	1 flush	-	500	1	800
Conventional Urinal (male)	1.0 gal/flush	1 flush	-	500	2	1000
Conventional Toilet (female)	1.6 gal/flush	1 flush	-	500	3	2400
Bathroom Sink	2.5 gal/min	0.25 min	-	1000	3	1875
Conventional Shower	2.5 gal/min	5 min	-	100	1	1250
Kitchen Sink	2.5 gal/min	45 min	-	2	2	450
Clothes Washer	40 gal/load	1 load	-	-	10	400
					Total Daily Volume	**8175**
					Number of School Days	**180**
					Baseline Total Annual Volume	**1,471,500**

Comparing the two spreadsheets, the water-efficient fixtures reduced potable water use by:

% Savings = 1 – (Design Total Annual Volume / Baseline Total Annual Volume)

= 1 – (526,320/1,471,500) = 0.64 = 64%

Therefore, this design would earn a total of three points: two points because total potable water use has been reduced by over 30% and one point because potable water use for sewage conveyance has been reduced by more than 45%.

Resources

CHPS Best Practices Manual, Volume II: OS6: Efficient Terminal Devices; OS7: Waterless Urinals.

LEED™ Reference Guide: Water Credit 2: Innovative Waste Water Technologies; Water Credit 3: Water Use Reduction.

MATERIALS

Waste Reduction and Efficient Material Use

Purpose: Reduce the amount of construction and occupant waste entering the landfill and promote the efficient reuse of materials and buildings.

Materials Prerequisite 1: Storage and Collection of Recyclables

Required	P1.1. The building/school shall meet local ordinance requirements for recycling space; ***AND*** provide an easily accessible area serving the entire school that is dedicated to the separation, collection, and storage of materials for recycling including—at a minimum—paper (white ledger, mixed, and cardboard), glass, plastics, and metals.

In Washington, some local municipalities have ordinances requiring areas for collection and loading of recyclable materials in development projects. Areas without local ordinances should refer to the Resource Venture's Occupant Recycling Guide, http://www.resourceventure.org/PDF/Occupant_Recycling.pdf, which is based on the City of Seattle's ordinance.

Reserve space for recycling functions early in the building occupancy programming process and show areas dedicated to the collection of recycled materials on space utilization plans. Broader recycling space considerations should allow for collection and storage of the required elements, as well as the recycling of newspaper, organic waste (food and soiled paper), and dry waste. An innovation credit can be earned for designing a food waste minimization and diversion space program. (See Extra Credit 2.2.) Collection bins should accommodate a 75% diversion rate and be easily accessible to custodial staff and recycling collection workers. Consider bin designs that allow for easy cleaning to avoid health concerns. Ensure that the spaces are synergistic with the policies of local waste handling companies. Control odors by separately venting these areas.

Resources
Resource Venture's Occupant Recycling Guide:
http://www.resourceventure.org/PDF/Occupant_Recycling.pdf.

Materials Credit 1: Site Waste Management

Meet local ordinance requirements for managing construction and demolition materials at construction sites, if applicable;

AND develop and implement a waste management plan, quantifying material diversion by weight to:

1 point	1.1. Recycle, compost, and/or salvage at least 50% (by weight) of construction, demolition, and land clearing waste.
1 point	1.2. Recycle, compost, and/or salvage an additional 25% (a total of 75% by weight) of the construction, demolition, and land clearing debris.

Develop and specify a waste management plan that identifies licensed haulers and processors of recyclables; identifies markets for salvaged materials; employs deconstruction, salvage, and recycling strategies and processes; includes waste auditing; and documents the cost for recycling, salvaging, and reusing materials. Source reduction on the job site should be an integral part of the plan.

The plan should address recycling of corrugated cardboard, metals, concrete brick, asphalt, land clearing debris (if applicable), beverage containers, clean dimensional wood, plastic, glass, gypsum board, and carpet. It must also evaluate the cost-effectiveness of recycling rigid insulation, engineered wood products, and other materials.

Compliance calculations for this credit must be based on weight. Many recycling and landfill facilities weigh incoming materials. Shipments that cannot be weighed can be estimated based on their volume and density.

$$\text{Recycle Rate (\%)} = \frac{\text{Recycled Waste [Tons]}}{\text{Recycled Waste [Tons]} + \text{Garbage [Tons]}} \times 100\ \%$$

Resources

CHPS Best Practices Manual, Volume II: Guideline GC2: Construction and Demolition Waste Management.

Construction Recycling, a web page of the Business and Industry Resource Venture. http://www.resourceventure.org/.

LEED™ Reference Guide: Materials Credit 2: Construction Waste Management.

Materials Credit 2: Building Reuse

Earn one of the following credits.

1 point	2.1. Maintain (i.e., reuse) at least 75% of existing building structure and shell (exterior skin and framing, excluding window assemblies).
1 point	2.2. Maintain (i.e., reuse) an additional 25% (100% of total) of existing building structure and shell (exterior skin and framing, excluding window assemblies).
1 point	2.3. Maintain (i.e., reuse) 100% of existing building structure and shell; ***AND*** at least 50% of non-shell (walls, floor coverings, and ceiling systems).

Reusing parts of the building can save significant money and resources, while greatly reducing the amount of construction waste. When materials are reused, the environmental benefits start with resource savings and extend down through the entire lifecycle of the material: less energy is spent extracting, processing, and shipping the materials to the site. Depending on the amount of building reused, school districts can significantly reduce their construction and material costs. However, the building envelope will significantly affect many important high performance areas, such as space programming, energy performance, opportunities for daylighting, and indoor air quality. In addition, care must be taken to ensure that any environmental hazards such as toxins, lead, and asbestos have been identified and addressed. Develop a list of benefits and tradeoffs, and make the decision based upon the overall, integrated design tradeoffs.

Credits 2.1 and 2.2. Calculating the percent of building reused is a three-step process. This methodology produces the same results as the calculations described in the *LEED-NC Version 2.1 Reference Guide*, pp 196-197.

Step1. Approximate total structural materials and reused structural materials (foundation, slab on grade, beams, floor and roof decks, etc) in terms of cubic feet. Divide the reused structural materials (cf), by the total structural materials (cf), to get the percent of structural materials that are reused.

Step 2. Approximate total shell materials and reused shell materials (roof and exterior walls) in terms of square feet. Divide the reused shell materials (ft^2), by the total shell materials (ft^2), to get the percent of shell materials that are reused.

Step 3. Calculate the approximate building reuse percentage, by adding together the structural and shell reuse percentages from Step 1 and Step 2, and dividing the sum by two.

$$\text{Building Reuse (\%)} = \frac{\text{Structural Materials Reused [\%] from Step 1} + \text{Shell Materials Reused [\%] from Step 2}}{2}$$

Here is look at the whole calculation.

$$\text{Building Reuse (\%)} = \frac{\dfrac{\text{Reused Structural Materials [cf]}}{\text{Total Structual Materials[cf]}} + \dfrac{\text{Reused Shell Materials[ft}^2\text{]}}{\text{Total Shell Materials[ft}^2\text{]}}}{2}$$

Credit 2.3. Percentage of reused, non-shell building portions will be calculated as the total area (ft^2) of reused walls, floor covering, and ceiling systems, divided by the existing total area (ft^2) of walls, floor covering, and ceiling systems.

This methodology produces the same results as the calculations described in the *LEED-NC Version 2.1 Reference Guide*, pp 196-197.

Resources

LEED™ Reference Guide: Materials Credit 1: Building Reuse.

Materials Credit 3: Resource Reuse

1 point	3.1. Install salvaged or refurbished materials for 5% of building materials.
1 point	3.2. Install an additional 5% of salvaged or refurbished materials (a total of at least 10% of building materials).
1 point	3.3. Install salvaged, refurbished, or used furniture and equipment for at least 30% of total furniture and equipment budget.

Calculate percentages for these credits using total and salvaged materials costs. Exclude all labor costs, all mechanical and electrical material costs, and project overhead and fees. If the cost of the salvaged or refurbished material is below market value, use replacement cost to estimate the material value; otherwise use actual cost to the project.

Credit 3.1 and 3.2. Re-used materials or products are salvaged from a previous use or application and then used in a new use or application with only minor modification, finishing, or repair. Commonly salvaged building materials include wood flooring/paneling/cabinets, doors and frames, mantels, ironwork and decorative lighting fixtures, brick, masonry, heavy timbers, and on-site concrete used as aggregate. Ensure the salvaged materials, especially structural elements, comply with all applicable codes.

Calculate percentages using materials costs, as illustrated below:

$$\text{Salvage Rate [\%]} = \frac{\text{Salvaged Material Cost[\$]}}{\text{Total Material Cost[\$]}} \times 100\ \%$$

Credit 3.3. In order to reduce the demand for virgin materials and reduce waste, and the associated impacts of extraction, processing and manufacturing new materials, purchase used and refurbished furniture and equipment. Furniture and equipment would include items like case pieces, desks and chairs, tables, filing systems, decorative lighting and accessories, as well as computers, printers, copiers, fax machines, and other electrical equipment common in schools.

As above, calculate percentages using materials costs:

$$\text{Salvaged F\&E Rate [\%]} = \frac{\text{Salvaged Furniture and Equipment Cost[\$]}}{\text{Total Furniture and Equipment Cost[\$]}} \times 100\ \%$$

Resources
CHPS Best Practices Manual, Volume II: Material Selection and Research Section; Interior Surfaces and Furnishings Chapter.

LEED™ Rating System for Commercial Interiors Pilot Draft, Materials Credit 3.3: Resource Reuse, 30%.

LEED™ Reference Guide: Materials Credit 3: Resource Reuse.

Sustainable Materials

Purpose: Increase demand for building products that have incorporated recycled content material, reducing the impacts resulting from extraction of new material; reduce the use and depletion of finite raw and long-cycle renewable materials by replacing them with rapidly renewable materials; encourage environmentally-responsible forest management; and avoid materials that accumulate in the atmosphere.

Materials Credit 4: Recycled Content

1 point	4.1. Performance Approach: Use materials with recycled content such that the sum of post-consumer recycled content plus one-half of the post-industrial content constitutes at least 5% of the total value of the materials in the project. Recycled content materials shall be defined in accordance with the Federal Trade Commission document, *Guides for the Use of Environmental Marketing Claims, 16 CFR 260.7 (e)* ***OR*** Prescriptive Approach: Install at least four major materials from the Construction Products category of the *EPA Comprehensive Procurement Guidelines 2000 Buy-Recycled Series*.
1 point	4.2. Performance Approach: Use materials with recycled content such that the sum of post-consumer recycled content plus one-half of the post-industrial content constitutes *an additional* 5% (a total of at least 10%) of the total value of the materials in the project. Recycled content materials shall be defined in accordance with the Federal Trade Commission document, *Guides for the Use of Environmental Marketing Claims, 16 CFR 260.7 (e)* ***OR*** Prescriptive Approach: Install at least eight major materials from the *EPA Comprehensive Procurement Guidelines*. At least six building materials must be from the Construction Products Category.

The number and variety of products using recycled content materials expands every year. Using these materials closes the recycling loop by creating markets for materials collected through recycling programs across the country. It also reduces the use of virgin materials and landfill waste. Recycled-content alternatives exist for all major building materials and surfaces.

Recycled content is classified as either post-consumer (collected from end users) or post-industrial. Post-industrial (also known as secondary material or pre-consumer) is collected from manufacturers and industry. The objective is to maximize post consumer recycled content.

The US EPA's Comprehensive Procurement Guideline program provides fact sheets for various product categories as well as a list of materials with recommended recycled content levels.

Performance Approach.

The total recycled content value is calculated in five steps. Mechanical and electrical components shall not be included in these calculations. These calculations are consistent with methodology discussed in *LEED NC Version 2.1 Reference Guide*, pp 217-219.

Step 1. For each material, identify the percentage of post-consumer recycled content (by weight), the percentage of post-industrial recycled content (by weight), and the material cost.

Step 2. For each material, use info from Step 1 to calculate the Post Consumer Recycled Content Value, as shown below

Post Consumer Recycled Content Value [$] = $\text{Material Cost (\$)} \times \text{Post Consumer Recycled Content [\%]}$

Step 3. For each material, use info from Step 1 to calculate the Post Industrial Recycled Content Value, as shown below

Post Industrial Recycled Content Value [$] = $\text{Material Cost (\$)} \times \text{Post Industrial Recycled Content [\%]}$

Step 4. Sum the total value of all materials.

Step 5. Calculate **Recycled Content Percentage for this Credit**, which equals the combined value of post consumer recycled content (from Step 2) plus one-half of post industrial recycled content (from Step 3) as a percentage of total value of all materials, as shown below.

Recycled Content Percentage for this Credit =

$$\frac{\text{Total Post Consumer Recycled Content Value [\$]} + (1/2)\ \text{Post Industural Recycled Content Value [\$]}}{\text{Total Project Material Cost [\$]}} \text{ X } 100\%$$

Earn 1 point if: Recycled Content Percentage for this Credit (%) = 5% or more

Earn an additional 1 point if: Recycled Content Percentage for this Credit (%) = 10% or more.

Credit 4.1. **Prescriptive Approach.** Install at least four major materials from the Construction Products category of the *EPA Comprehensive Procurement Guidelines 2000 Buy-Recycled Series*. A "major" material is defined as those materials covering more than 50% of a major building surface (such as parking areas, floor, roof, partitions, walls), or serving a structural function throughout the majority of the building. *EPA's Comprehensive Procurement Guidelines* are available at: http://www.epa.gov/cpg.

For the purposes of these prescriptive points, nylon carpeting with at least 50% recycled-content materials can be used in addition to the carpet with recycled polyester (PET resin) materials listed on the EPA's site. (Some PET carpets are not sufficiently durable for school applications.)

Credit 4.2. Eight major materials must be installed from the EPA's Comprehensive Procurement Guidelines, and at least six must be from the construction products category.

Resources
CHPS Best Practices Manual, Volume II: Interior Surfaces and Finishes Chapter.

EPA's Comprehensive Procurement Guideline Program: http://www.epa.gov/cpg/products.htm - construct.

Guides for the Use of Environmental Marketing Claims, 16 CFR 260.7 (e), Federal Trade Commission document, available at www.ftc.gov/bcp/grnrule/guides980427.htm.

King County Guide to Recycled Building Materials:
http://dnr.metrokc.gov/swd/bizprog/sus_build/RCBMG.pdf.

LEED™ Reference Guide: Materials Credit 4: Recycled Content.

Resource Venture's "Buy Recycled" resource page: http://www.resourceventure.org/buy_recycled.htm.

Materials Credit 5: Rapidly Renewable Materials

1 point	5.1. Install rapidly renewable building materials for 5% of total building materials.

Rapidly renewable resources are those materials that substantially replenish themselves faster than traditional extraction demand (planted and harvested in less than a 10-year cycle). Products in this category include, but are not limited to, bamboo products, wheat grass cabinetry, oriented strand board and other wood products made from fast-growing poplar and Monterey pine trees, and linoleum. Ensure that the products are low emitting and are durable.

To earn this credit, determine the percentage of total building materials from rapidly renewable sources. Exclude all labor costs, all mechanical and electrical material costs, and project overhead and fees.

$$\text{Rapidly Renewable Material Portion [\%]} = \frac{\text{Rapidly Renewable material cost[\$]}}{\text{Total material cost[\$]}} \times 100\ \%$$

See Materials Credit 4 for discussion of how to determine the total material cost for the project.

Resources
CHPS Best Practices Manual: Volume II: Interior Surfaces and Finishes Chapter.

LEED™ Reference Guide: Materials Credit 6: Rapidly Renewable Materials.

Materials Credit 6: Certified Wood

1 point	6.1. At least 20% of the cost of wood-based materials and products are from a sustainable forest certified by a third party.
1 point	6.2. An additional 30% (a total of at least 50%) of the cost of wood-based materials and products are from a sustainable forest certified by a third party.
1 point	6.3. The third-party certification offers chain of custody verification for the project.

Historically, certified wood has often been difficult to procure in large quantities. However, certified wood mills, distributors and vendors have responded to the increased market demand and the products are more available. It is still important to order certified wood as early as possible to ensure the product is available when needed.

Sustainably certified wood is available for a variety of applications including framing and interior finishes (wood ceilings, casework, millwork, and flooring).

Compliance for this credit is based on cost of the certified wood as a percentage of total wood-based products. The following equation can be used to determine point level.

$$\text{Certified Wood Portion [\%]} = \frac{\text{Certified wood cost[\$]}}{\text{Total wood based cost[\$]}} \times 100\ \%$$

Wood-based products includes all wood consumed by the overall project including, but are not limited to, casework, formwork, shoring, structural framing and general dimensional framing, flooring, finishes, furnishings, and non-rented temporary pedestrian barriers used in construction.

The Forest Stewardship Council (FSC) system provides standards for the sustainable growth and harvest, and provides a chain-of-custody process for certified wood products that tracks the wood from harvesting, through milling, distribution, and retail. The sustainable forests in the FSC system are certified by a third party. As of August 2003, the FSC is the only sustainable forestry management system with a complete chain of custody verification in the United States.

In August 2003, there were four FSC certified forests (four companies) in Washington State covering 88,819 acres, with wood species including Western Red Cedar, Douglas Fir, Alder, Hemlock and Maple. There are mills, distributors and retailers of certified wood in both Eastern and Western Washington.

There are three other sustainable forestry management systems in North America. While currently none of these systems have a complete chain of custody verification process, the market for certified wood products is quickly changing, and these sustainable forestry systems may add a chain of custody verification process. The other certification systems include:

Sustainable Forestry Initiative (SFI). SFI is required for all American Forest & Paper Association (AF&PA) members. Third-party certification is optional. Chain of custody is not available.

CSA International. CSA is an independent non-profit organization accredited by the Standards Council of Canada. CSA is primarily focused on Canadian forests. Third-party certification is required. Chain of custody is available on limited scale.

American Tree Farm System is a program of the American Forest Foundation, and is primarily focused on non-industrial forests in the US. Third-party certification is required. Chain of custody is not available.

Resources
Certified Wood and Paper Association, http://www.cwpa.info.

Forest Certification Resource Center. Online database for search for certified wood products, http://www.certifiedwood.org/search-mo56+dules/SearchProducts.aspx.

LEED™ Reference Guide: Materials Credit 7: Certified Wood.

Materials Credit 7: Eliminate Ozone-Depleting Materials

1 point	7.1. All new base building equipment must be free of HCFCs and halons.

When released to the atmosphere, refrigerant compounds such as chlorofluorocarbons (CFCs), hydrochlorofluorocarbons (HCFCs), and halon photochemically react and cause depletion of ozone in the stratospheric ozone layer. CFCs and HCFCs are commonly used as refrigerants in HVAC equipment. HCFCs are not as reactive as CFCs (have a lower "ozone depleting potential" (ODP)), but they are still detrimental and, as such, are scheduled for eventual phase-out under the provisions of the US-adopted Montreal Protocol. Alternatives include HFC-based cooling equipment, which is increasingly available, cost effective, and energy efficient. However, at present, most existing and many new systems still use R-22, which is an HCFC scheduled for phase out by 2010.

Halons are used in fire suppression systems and fire extinguishers. These compounds have three to 10 times the ODP of HCFC compounds.

Resources
EPA Lists of Substitutes for Ozone-Depleting Substances, http://www.epa.gov/ozone/snap/lists/index.html#refac.

LEED™ Reference Guide: Energy and Atmosphere Credit 4: Ozone Depletion.

Materials Credit 8: Regional/Local Materials

1 point	8.1. Install materials that are manufactured within a 500-mile radius for 20% of building materials.
1 point	8.2. Install materials that are extracted, harvested or recovered from within a 500-mile radius for 20% of building materials. (These materials must also meet the definition of local/regional manufacture to earn this credit.)

Manufacturing, using the *LEED Reference Manual* definition, refers to "the *final assembly* of components into the building product that is furnished and installed by the tradesmen. For example, if the hardware comes from Seoul, South Korea, the lumber from Vancouver, British Columbia and the joist is assembled in Kent, Washington; then the location of the *final assembly* is Kent, Washington."

Regional and locally produced materials support the local economy while helping to reduce resource and energy consumption by minimizing transportation distances.

Buying regional/local materials is only one aspect of sustainable purchasing. Some materials may be local, but are not chosen because more distant products have higher recycled content, longer lifespan, or lower costs. And visa versa.

Base percentage calculations in terms of dollar value:

$$\text{Regional Material Portion [\%]} = \frac{\text{Regional material cost[\$]}}{\text{Total material cost[\$]}} \times 100\,\%$$

Resources

Northwest Builders Network Directory of NW Building Supply Manufacturers. http://www.nwbuildnet.com/nwbn/manufacturers.html.

LEED™ Rating System for Commercial Interiors Pilot Draft, Materials and Resources Credit 5: Regional Materials.

ENERGY

Energy Efficiency

Purpose: Reduce environmental impacts, capitol and operational costs associated with excessive energy use.

Energy Prerequisite 1: Minimum Energy Performance

Required	P1.1. The school design must meet the Washington State's Non-Residential Energy Code 2001 Edition (NREC) efficiency standards.

Energy-efficient schools save money while conserving non-renewable energy resources and reducing atmospheric emissions of pollutants and greenhouse gases. The 2001 NREC has been a major factor in this. While the NREC is considered an aggressive baseline for energy efficient construction practices, there are numerous cost-effective, practical, and straightforward measures that can reduce energy use by 10-20% from the 2001 NREC. Support for the NREC is provided by the Northwest Energy Efficiency Council (NEEC).

Energy efficiency will not happen in a vacuum. Commissioning, maintenance and training are vitally important to the performance of the school and its systems. Commissioning involves a rigorous quality assurance program that ensures the building is designed appropriately and built as it is designed. No building can perform optimally without maintenance. Training is critically important to ensure that the teachers and maintenance staff understand how to maintain and operate the building systems. When turnover occurs, appropriate documentation must be on-hand to ensure that new team members are properly trained.

Resources

Advanced Building Guidelines E-Benchmark: 2003 Edition, http://www.newbuildings.org/.

Advanced Lighting Guidelines: 2003 Edition, New Buildings Institute. http://www.newbuildings.org/.

BetterBricks. http://www.betterbricks.com/.

CHPS Best Practices Manual, Volume II. Energy efficiency is affected by most of the guidelines. In particular, consult the Daylighting, Electric Lighting, HVAC, Building Envelope, and Site Planning Chapters.

Energy Design Resources, http://www.energydesignresources.com/publications/design_briefs/index.html.

The Northwest Energy Efficiency Council (NEEC) provides support for Washington's Non-Residential Energy Code and offers compliance forms (Excel and pdf) and information on obtaining the reference manual, http://www.neec.net/resources/resources.html.

Public Interest Energy Research Project, California Energy Commission, http://www.newbuildings.org/pier/index.html.

Energy Credit 1: Superior Energy Performance

1.1. Reduce the source energy of the proposed design to be below what is required by NREC by increasing energy efficiency through the integrated design of system components.

4 points	10% reduction in total net energy use compared to NREC baseline.
6 points	20% reduction in total net energy use compared to NREC baseline.
8 points	30% reduction in total net energy use compared to NREC baseline.
10 points	40% reduction in total net energy use compared to NREC baseline.
12 points	50% reduction in total net energy use compared to NREC baseline.

OR

4 points	Incorporating the following design elements into the school: 1. Bi Level Controls. 2. Automatic Lighting Reduction. 3. Best Practices Mechanical System Design. 4. Opaque Envelope Performance. 5. Window Performance. 6. Skylight Performance. 7. Cool Roof. 8. Mechanical Efficiency. 9. Variable Air Volume. 10. Lighting Power Density. 11. Daylight Responsive Controls. Each of these measures is detailed below.

Investments in energy efficiency measures are cost-effective, and net reductions of 10% to 20% are feasible. When energy efficiency goals are established (and followed) in the design process, a wide array of measures can reduce energy use, with the amount of energy saved depending on local climate, the quality of the design, whether the interactions between the building systems have been optimized, the extent of commissioning, and the amount of training given to teachers and staff. Consider opportunities throughout the school in the following areas:

- Daylighting: Optimize the daylighting design to minimize glare and eliminate direct beam light in the classroom, use daylighting controls designed to dim or turn-off electric lights when sufficient daylight is available.
- HVAC systems: Use high efficiency equipment, correctly size for the estimated demands of the facility, use economizers and other controls that optimize system performance.
- Electric lighting: Use high efficiency products, optimize the number of light fixtures in each room, use occupant sensors and other control devices that ensure peak system performance, successfully integrate electric lighting and daylighting strategies.
- Enclosure: Ensure that walls, floors, roofs, and windows of the school are as energy efficient as cost-effectively possible.
- Commissioning. Commissioning is increasingly important as more savings are expected through energy conservation measures. It ensures that the school is built as designed, and operates as expected. See Energy Credit 4: Commissioning for more information.

Performance Approach. Include additional integrated design measures to increase the energy efficiency of the school. Perform energy analysis for selected design elements that affect energy performance and document compliance. Follow the requirements and guidelines outlined in the NREC.

The unit of measure for performance is source energy. The design earns from four to 12 points, based on the level of savings achieved. Interpolation to whole number point levels is allowed. For example, 22.5% savings would earn nine points. Extrapolation is not allowed.

Prescriptive Approach. Alternatively, designs that incorporate the following measures are assumed to save 10% of baseline energy and therefore earn four points. Note that while major renovations can take advantage of the following measures, it is recommended that they be evaluated using a performance modeling approach.

1. Bi-level Control. The control device shall allow the occupant to reduce the connected lighting load in a reasonably uniform illumination pattern by at least 50%.

Exceptions:

- Task lighting.
- Rooms that have only one luminaire.
- HID luminaires shall reduce the connected lighting load in a reasonably uniform illumination pattern by at least 40%.

2. Automatic lighting reduction. The automatic control device shall shut off lighting or reduce lighting for interior rooms.

All classrooms, offices and support rooms shall have occupant sensors that shall turn lighting off within 30 minutes of an occupant leaving a space.

All other spaces shall either have occupant sensors or use an automatic time switch control device capable of shutting off lighting. The Automatic time switch control device should use an independent program schedule that controls the interior lighting in areas that do not exceed 25,000 square feet and are not more than one floor. If an automatic time switch control device is installed, it shall incorporate an override switching device that:

a. Is readily accessible; and

b. Is located so that a person using the device can see the lights or the area controlled by that switch, or so that the switch serving the area being lit is annunciated; and

c. Is manually operated; and

d. Allows the lighting to remain on for no more than two hours when an override is initiated; and

e. Controls an area not exceeding 2,500 square feet for spaces under 10,000 square feet, and not exceeding 5,000 square feet for spaces over 10,000 square feet; and

f. Has an automatic holiday "shut-off" feature that turns off all loads for at least 24 hours, and then resumes the normally scheduled operation.

In areas with top-mount skylights, an automatic, photosensitive control device shall reduce the connected lighting load in a reasonably uniform illumination pattern by at least 50% while maintaining design illuminance. Each daylight control zone shall not exceed 2,500 square feet.

3. Best Practices Mechanical System Design. Employ best practices design techniques to improve system performance and meet *ASHRAE Standard 55*. The design engineer shall document the following actions in the design process:

a. When *sizing the heating and cooling equipment*, perform load calculations using interior load assumptions, including using the design interior lighting, accounting for the actual glazing characteristics, providing credit for displaced loads if displacement or underfloor systems are used, and base miscellaneous loads on field-verified measurements or field-based research

rather than typical owner programming assumptions. Where not feasible, document the non-standard load assumptions for owner concurrence.

b. When *sizing the fan and air distribution systems*, document fan-sizing calculations with zone-by-zone load calculations. Perform calculations to determine critical path supply duct pressure loss. Compare fitting selections for the critical branch to minimize fan horsepower requirements. Utilize round or oval duct wherever feasible to lower leakage and reduce pressure loss. Separate all fittings in medium and high-pressure ductwork by several duct diameters to reduce system effects wherever feasible. Use relief fans in lieu of return fans where possible and provide automatic dampers on exhaust in lieu of barometric dampers to reduce fan power and increase barometric relief.

c. *Perform a second set of calculations* using part-load conditions (maximum likely load and/or standard operating conditions). This includes using benchmark data, average daytime temperatures and non-peak solar gain, and other assumptions to define part load conditions for the heating and cooling system. Include diversity factors for interior loads and other factors that will allow proper assessment of part-load operation.

Describe the system operation at these conditions and describe features of the design that will facilitate efficient operation at these part-load conditions.

4. Opaque Envelope Performance. Walls, roof assemblies, floors, and slabs-on-grade which are part of the building envelope for buildings where window and glazed door area is not greater than 40% of the gross area of above-grade walls shall meet the criteria shown in Table 1 in the Appendix.

5. Window Performance. Window systems which are part of the building envelope for buildings where window and glazed door area is not greater than 40% of the gross area of above-grade walls shall meet the criteria shown in Table 2 in the Appendix. Each vertical fenestration system must meet the U-Factor, the SHGC for the corresponding projection factor, and the VLT specification

6. Skylight Performance. Skylight systems which are a part of the roof assembly where the skylight area is not greater than 5%of the gross roof area shall meet the criteria shown in Table 3 in the Appendix. Each horizontal fenestration system must meet the U-factor and the SHGC.

7. Cool Roof. On low-slope roofs (2:12 or less): Install an ENERGY STAR® labeled Cool Roof with an emmissivity of at least 0.9 for a minimum of 75% of the roof surface or install an ecoroof for a minimum of 50% of the roof surface.

8. Mechanical Efficiency. Mechanical equipment shall meet the following:

a. Package unitary equipment shall meet the minimum efficiency requirements in Tables 4 and 5 in the Appendix and be ENERGY STAR® labeled (where applicable).

b. Gas unit heaters shall include an intermittent ignition device and have either power venting or a flue damper.

c. Package terminal air conditioners and heat pumps shall meet the minimum efficiency requirements in Table 6 in the Appendix.

d. Boilers over 300,000 Btu/hr shall meet the minimum efficiency requirements in Table 7 in the Appendix.

e. Electric chillers shall meet the energy efficiency requirements in Table 8 in the Appendix.

f. Absorption chillers shall meet the minimum efficiency requirements in Table 9 in the Appendix.

g. Equipment not listed shall meet ENERGY STAR® criteria where applicable.

9. Variable Speed Control. Individual pumps serving variable flow systems and VAV fans having a motor horsepower of 10 hp or larger shall have controls and/or devices (such as variable speed control) that will result in pump or fan motor demand of no more than 30% of design wattage at 50% of design flow.

10. Lighting Power Density. Installed lighting equipment power density shall not exceed the allowed lighting equipment power density as shown in Table 10 in the Appendix. This requirement is based on the application of high-efficacy sources to industry standard lighting models.

11. Daylighting Responsive Lighting Control. In daylit areas, automatic daylight responsive lighting controls shall be installed that meet the following requirements:

a. Controls the lights in the daylit area separately from he non-daylit areas.

b. Automatically reduces electrical lighting power in response to available daylight in a daylit area by either;

   i. A combination of dimming ballasts and daylight-sensing automatic controls that are capable of automatically reducing the power of general lighting in the daylit zone continuously to less than 35% of rated power at maximum light output.

   ii. A combination of multi-level switching and daylight-sensing controls that is capable of reducing the lighting power automatically. If the control is a switching control, it shall provide at least two control channels per zone and be installed in a manner such that at least one control step shall reduce power of general lighting in the daylit zone by 30% to 50% of rated power and another control step shall reduce lighting power by 65% to 100%. This control shall be capable of automatically reducing the general lighting in the daylit area in multiple steps in response to available daylight while maintaining a reasonably uniform and appropriate level of illuminance.

c. The light sensor shall be separate from where setpoint adjustments are made; and

d. The controls for calibration adjustments to the lighting control device shall be readily accessible to authorized personnel.

Exceptions:

- Daylight spaces enclosed by floor to ceiling partitions containing only one luminaire.
- Lighting required by a health or life safety statute, ordinance or regulation, including but not limited to emergency lighting.
- Lighting for steps or stairs that require illumination during daylight hours.
- Lighting for theatrical purposes, including performances, stage, film production and video.

Resources

Advanced Buildings, http://advancedbuildings.org/_frames/fr_links.htm.

Advanced Building Guidelines E-Benchmark: 2003 Edition, http://www.newbuildings.org/.

Advanced Lighting Guidelines: 2003 Edition, http://www.newbuildings.org/.

Air-Conditioning and Refrigeration Institute, http://www.ari.org/.

BetterBricks, http://www.betterbricks.com/.

CASE Initiative: High-Albedo Roofs, PG&E, http://www.newbuildings.org/architecture.htm.

CHPS Best Practices Manual, Volume II. Much of Volume II is dedicated to energy efficient design strategies including the chapters on Daylighting, Electric Lighting, HVAC, and Building Envelope.

Cool Roof Rating Council, http://www.coolroofs.org/.

Design Guidelines for Skylights with Suspended Ceilings. New Buildings Institute Public Interest Energy Research Project (PIER) http://www.newbuildings.org/pier/index.html.

EPA EnergyStar, http://www.energystar.gov/.

IESNA Lighting Power Density Models, http://www.iesna.org/.

International Energy Conservation Code 2003, http://www.intlcodes.org/.

LEED™ Reference Guide: Energy and Atmosphere Credit 1: Optimize Energy Performance.

Large VAV System Design Guide, Small Package HVAC System Design Guide. New Buildings Institute Public Interest Energy Research Project (PIER). http://www.newbuildings.org/pier/index.html.

The Northwest Energy Efficiency Council (NEEC) provides support for Washington's Non-Residential Energy Code and offers compliance forms (Excel and pdf) and information on obtaining the reference manual, http://www.neec.net/resources/resources.html.

Portland, Oregon Office of Sustainable Development, http://www.sustainableportland.org/.

Energy Credit 2: HVAC and Operable Windows

1 point	2.1. Install controls/devices or HVAC systems that are responsive to operable windows or doors when opened.

Credit 2.1. It is recommended that each classroom have an operable window. IEQ Credit 2 (Daylighting) has one point for view windows in classrooms and IEQ Credit 6 (Teacher Control) offers another credit if the window is operable. However, care must be taken to properly control the operable windows with HVAC responsive controls.

Each year, significant amounts of energy are lost when teachers or staff members open exterior doors or windows while HVAC systems are operating. Controls should be installed to set back HVAC systems to unoccupied settings when windows and doors are opened for extended periods. Controls must be included so that normal use of the doors does not cause the HVAC systems to cycle on and off unnecessarily, and teachers must be educated on how the system works and why it is needed. In addition, the controls should not turn off the ventilation fans, but adjust the thermostat settings to unoccupied levels or what is commonly called the “night setback”. Adequate amounts of ventilation must be supplied to the classroom at all times.

However, with proper design and adequate maintenance, teachers should have no reason to open the doors. If the ventilation system cannot remove stale air and odors, teachers are often forced to open exterior doors or windows to improve comfort. Portables are particularly susceptible to this problem, especially if the HVAC systems are not ducted. Other times, in spaces with small or no windows, teachers and staff open the doors for a connection to the outdoors. Both of these issues can, and should, be addressed with better design and adequate maintenance. Insufficient ventilation can have serious health effects on the students, teachers, and other staff members.

Resources
CHPS Best Practices Manual, Volume II: Guideline TC1: Cross Ventilation; Guideline TC2: Stack Ventilation; Guideline TC3: Ceiling Fans.

Alternative Energy Sources

Purpose: Reduce environmental impacts and increased operational costs associated with excessive energy use.

Energy Credit 3: Renewable Energy and Distributed Generation

3.1. Use on-site renewable energy and distributed generation for a portion of a school's energy use. The table below shows the point levels corresponding to the percentage of net energy use supplied by alternative sources.

For Renewable Energy Sources	For On-site Distributed Generation	% Of Net Building System's Energy Supplied from Alternative Sources
2 points	1 point	5%
3 points	1 point	7.5%
4 points	2 points	10%

Employ on-site renewable energy technologies or distributed generation to supply part of the building energy. Systems include:

Renewable Energy Sources	Distributed Generation
Photovoltaics Wind Geothermal (not including ground source heat pumps) Fuel cells utilizing biogas	Fuels cells utilizing non-renewable fuels and waste heat recovery. Microturbine utilizing waste heat recovery.

On-site renewable energy and distributed generation have many benefits. Renewable sources, such as photovoltaics, wind turbines, and geothermal sources, use the sun, air, and earth instead of non-renewable, polluting sources, such as coal or natural gas. The distributed generation systems listed in the table above all use non-renewable fuels. However, their improved efficiencies and technologies produce less air pollutants than traditional, centrally located coal or natural gas plants. Fuel cells can be powered by either renewable (biogas) or non-renewable (natural gas) sources, and are included in both categories.

Sources covered under this credit must be located at the school site, eliminating the environmental impacts and transmission losses associated with remote sources. On-site sources can become very effective components of school curriculums, educating students on a wide variety of energy and science issues.

The costs and feasibility of on-site renewables and distributed generation vary significantly with location, technology, site-specific constraints, and maintenance concerns. Typical school installations supply less than 5% of total energy. Renewable systems generally reach a point of diminishing returns before they supply 100% of total energy. Incentive or "buy-down" programs from state or local energy providers can substantially reduce first-costs.

Sources should be installed using net metering. Net metering attaches the on-site system to the electrical power grid. When the school produces more energy than it uses, the excess energy is traded back to the local energy provider. In essence, this "spins the meter backwards" and is vital to the cost-effectiveness of the system. At the time of this writing (Fall 2003), facilities with on-site renewables and net metering could only receive credit up to the amount of energy they used. In other words, buildings could only "zero-out" their utility bill and not make a profit from selling their excess energy.

To earn points with this credit:

1. Model the school building systems (no plugloads) to estimate the amount of energy used annually (Q_{school}). Employ figures from Energy Prerequisite 1 or Energy Credit 1 if the performance approach is used.
2. Calculate the amount of energy the particular on-site renewable or distributed generation system can supply annually ($Q_{alternative}$).
3. Calculate the net amount of energy provided by renewables ($Q_{alternative}/Q_{school}$).

Resources
CHPS Best Practices Manual, Volume II: Guideline OS1: Photovoltaics.

LEED™ Reference Guide: Energy and Atmosphere Credit 2: Renewable Energy.

Commissioning and Training

Purpose: Verify that fundamental building elements and systems are designed, installed, and operate as intended by the construction documents.

Energy Prerequisite 2: Fundamental Building Systems Testing and Training

Required	P2.1 The design team and the school district shall comply with the completion requirements outlined in Section 1416 of Washington's NREC and WAC 180-27-080 regarding: ▪ Drawings ▪ Manuals ▪ System balancing ▪ System commissioning

Drawings: Construction documents shall require that within 90 days after the date of system acceptance, record drawings of the actual installation be provided to the building owner. Record drawings shall include as a minimum the location and performance data on each piece of equipment, general configuration of duct and pipe distribution system, including sizes, and the terminal air and water design flow rates.

Manuals: Construction documents shall require an operating manual and maintenance manual be provided to the building owner. The manual shall be in accordance with industry accepted standards and shall include, at a minimum, the following:

- Submittal data stating equipment size and selected options for each piece of equipment requiring maintenance.
- Operation and maintenance manuals for each piece of equipment requiring maintenance, except equipment not furnished as part of the project. Required routine maintenance actions shall be clearly identified.
- Names and addresses of at least one service agency.
- HVAC controls system maintenance and calibration information, including wiring diagrams, schematics, and control sequence descriptions. Desired or field determined set points shall be permanently recorded on control drawings at control devices, or, for digital control systems, in programming comments.
- A complete narrative of how each system is intended to operate including suggested set points.

System Balancing: Construction documents shall require that all HVAC systems be balanced in accordance with generally accepted engineering standards. Air and water flow rates shall be measured and adjusted to deliver final flow rates within 10% of design rates, except variable flow distribution systems need not be balanced upstream of the controlling device (for example, VAV box or control valve). Construction documents shall require a written balance report be provided to the owner.

- **Air System Balancing:** Air systems shall be balanced in a manner to first minimize throttling losses then, for fans with system power of greater than 1 hp, fan speed shall be adjusted to meet design flow conditions.
- **Hydronic System Balancing:** Hydronic systems shall be proportionately balanced in a manner to first minimize throttling losses, then the pump impeller shall be trimmed or pump speed shall be adjusted to meet design flow conditions. Each hydronic system shall have either the ability to measure pressure across the pump, or test ports at each side of each pump.

Exceptions:

- Pumps with pump motors of 10 hp or less.
- When throttling results in no greater than 5% of the nameplate horsepower draw above that required if the impeller were trimmed.

Systems Commissioning: Commissioning shall include documentation, reports, and acceptance as specified by Washington's NREC WAC 180-27-080.

Resources:
CHPS Best Practices Manual, Volume II: Guideline GC5: Contractor's Commissioning Responsibilities.

Commissioning Process, http://www.peci.org/.

EPA Target Finder, http://www.energystar.gov/.

Guide to Building Commissioning, Energy Design Resources, http://www.energydesignresources.com/.

International Performance Measurement and Verification Protocol, http://www.ipmvp.org/.

PIER Construction Specifications, http://www.newbuildings.org/.

School Facilities Manual, Washington State Office of the Superintendent of Public Instruction, 4th Edition, March 2000, available online at http://www.k12.wa.us/facilities/SFMANUAL/intro.pdf.

Energy Credit 4: Commissioning

1 points	4.1. Develop a joint statement of project goals and principles through a facilitated discussion prior to the completion of the concept design or schematic design phase, but may occur after site selection and finance approval. This statement should be completed BEFORE the design development begins.
1 point	4.2. Hire a commissioning agent (CxA), independent of the design and construction management team, to provide commissioning services. The CxA must maintain certification credentials from either the Building Commissioning Association or an equivalent organization. The CxA shall: 1. Conduct a peer review of the design development, construction documents, specifications and bid submittals in PS2.1 and PS2.2. The CxA shall certify that the final contract documents reflect the operational performance requirements identified in PS2.1 and develop a commissioning plan. 2. Attend regular meetings with the school district to review construction progress, pre-functional test requirements and witness acceptance test results. They shall verify test results and complete all documentation required by PS2.2. 3. Review the final commissioning report with school district and verifying that PS2.3 is completed.

Do not underestimate the value of commissioning.

Buildings, even simple structures, are complex systems of electrical, mechanical, and structural components. High performance buildings are healthy, efficient, environmentally sensitive structures whose performance can be significantly affected if the building has not been designed following the district's intent or constructed according to the designers' specifications. Commissioning is a rigorous quality assurance program administered by a knowledgeable third party that ensures the building performs as expected.

The requirements of this credit are split into two levels of commissioning. The first credit (4.1) should be a part of all school construction programs. The second credit (4.2) expands the scope to include design, construction documentation, and submittal review.

Credit 4.1. This credit ensures that the design is developed in a way that meets the objectives of the building program including energy and environmental needs. This discussion provides information on broader impacts of design decisions and motivates the team to achieve specific targets. It also allows for interdisciplinary awareness and thinking.

The design team, along with the building school district and project team, shall complete a joint statement of energy and environmental goals and principles. This statement shall be developed through a facilitated discussion BEFORE the schematic design process has concluded.

The statement establishes foundational principles and goals for the project and must address the following issues:

- Site development
- Materials
- Indoor environment quality
- Energy
- Facility character
- Construction

- Operation

Meeting participants include, at a minimum, any project team members identified at this early stage of the project. The following project team members must be present:

- School district
- Architect
- Mechanical engineer
- Electrical engineer and/or lighting designer
- General contractor
- Leasing agent (if speculative development)
- Dedicated facilitator

Credit 4.2. Additional commissioning utilizes P2.1, P2.2, and P2.3 as a framework to deliver building commissioning services through an independent, certified third party. Contracting for commissioning process services through a separate, independent professional or utilizing school district's employees enables the commissioning agent (CxA) to focus on the commissioning process and to avoid potential conflicts of interest.

In schools under 15,000 square feet, the CxA may be an employee, associate, or partner of the architect, engineer or construction management firm; they should not however be part of the design team or construction management team. Whenever this choice is selected by the school district, the CxA should be separated from the design element or construction management unit in order to provide the school district with the independence required for the Commissioning Process to be successful and to avoid any conflicts of interest.

Resources
ENERGY STAR® for Business,
http://www.energystar.gov/index.cfm?c=tools_resources.bus_energy_management_tools_resources.

EPA ENERGY STAR® Target Finder,
http://www.energystar.gov/index.cfm?c=target_finder.bus_target_finder.

EZ-Sim Billing Simulation Tool, http://www.ezsim.com/.

Green Building Services, http://www.greenbuildingservices.com/services/eco_charrette.asp.

Guide to Building Commissioning, Energy Design Resources, http://www.energydesignresources.com/.

International Performance Measurement and Verification Protocol, http://www.ipmvp.org/.

LEED™ Reference Manual: Energy and Atmosphere Prerequisite 1: Energy and Atmosphere Credit 3.

Portland Energy Conservation, Inc., http://www.peci.org/.

Energy Credit 5: Energy Management Systems

1 point	5.1. Install an energy management system (EMS) to monitor the energy use of the following systems throughout the school (including all portables). ▪ Lighting (Internal and external) ▪ Equipment (plug loads) ▪ HVAC (heating, cooling, fans) ▪ Hot water

Credit 5.1. Energy management systems (EMS) are typically installed in new schools. However, care must be taken to specify and install an appropriate system for the district and maintenance staff. An appropriate EMS is the simplest system that still addresses the school's needs. Increased complexity does not always mean increased value for the district. EMS systems can potentially save significant energy, but only if the staff understands how to operate it. Proper training of district staff is critical, and high turnover rates continue to challenge school districts.

Control systems design shall include:

1. Sensors should be provided as follows:

a) Sensors to monitor and *trend* (create trend logs) at the operator interface controlled variables. Control variables may include air and/or water flow, temperature, pressure, CO_2, and pump or fan speed.

b) Sensors to trend outdoor air temperature.

c) In marine and humid climates, sensors to trend humidity.

d) Sensors to monitor and trend equipment status for all equipment with motors greater than 1/2 hp.

e) Indication and trending of damper and valve commanded position.

f) Sensors to monitor building electrical and natural gas demand and consumption.

g) Sensors to monitor indoor and outdoor CO_2.

Relevant multiplexed data from microprocessors located in chillers, boilers, humidifiers, VAV box controllers, variable speed drives, and other HVAC equipment with multiplexing capabilities may be used in lieu of specifying separate sensors.

Wells and other ports shall be specified for the installation of calibration devices to facilitate calibration of sensors.

Exceptions:

- Unit heaters, cabinet heaters, radiation and convectors located in vestibules, storage rooms, janitor closets, and other unoccupied areas.
- Natural gas demand sensors not required on buildings less than 50,000 ft^2.

2. Points Matrix: A *points matrix* including all hardwired input and output devices connected to the automation system, all setpoints, upper and lower control limits.

3. Trend Capabilities: *Trend requirements* including a trend point list and preprogrammed sample of point (performed by controls contractor), sample rate, storage interval, upload interval, custom trend abilities, alarms, and automated trend data review and notification (automated diagnostics).

4. System Architecture: A *system architecture* capable of allowing sampling of these points to facilitate building commissioning and diagnostics without significantly affecting system performance.

5. Data Storage: A *data storage system* with adequate capacity to record trend data for use by building operators. Data export requirements must facilitate user-friendly data access and manipulation.

6. Operator Interface: An *operator interface* designed for remote/web access, monitoring requirements, trend-log reporting and diagnosing building problems through a user-friendly interface. This includes providing a visual (non-text based) operations and reporting interface to facilitate rapid system assessment that utilizes color coding, diagrams of floor plans and graphing capabilities.

Monitoring capabilities should allow for comparison between various types of building loads throughout all spaces of the school (including portables). This information is valuable and can be used to manage and optimize energy use.

Resources
CHPS Best Practices Manual, Volume II: Guideline TC23: Adjustable Thermostats; Guideline TC24: EMS/DDC; Guideline EL4: Lighting Controls for Classrooms.

School Facilities Manual, Washington State Office of the Superintendent of Public Instruction, 4th Edition, March 2000, available online at http://www.k12.wa.us/facilities/SFMANUAL/intro.pdf.

INDOOR ENVIRONMENTAL QUALITY

Daylighting

Purpose: Improve student productivity and building energy efficiency through quality daylighting designs that minimize glare and direct sunlight penetration, and integrate daylight with the control of electric lighting in daylighted spaces. Quality daylighting as an integrated foundation for quality light can be accomplished by following the CHPS Daylighting Guidelines and Design Patterns DL1 to DL8 as discussed in *CHPS Best Practices Manual, Volume II -- Design*, Daylighting and Fenestration Chapter.

Provide a connection between indoor spaces and the outdoor environment through the introduction of daylight and views into the occupied areas of the building.

Automate the control of electric lighting levels by the introduction of daylight responsive photo-controls of the daylight zone electric lights, per *CHPS Best Practices Manual, Volume II – Design,* Electric Lighting and Controls Guideline and Controls Guideline EL4.

IEQ Prerequisite 1: Daylighting in Classrooms

Required *[For new construction ONLY]* 3 points *[Available for renovation ONLY]*	P1.1. Achieve a 2% minimum daylight factor (DF) of uniformly distributed daylight in 50% of critical visual task spaces with no direct sunlight penetration to surfaces commonly visible from critical task areas. Direct sun must be eliminated for daylighted spaces with the use of fixed position shading devices such as various louvers, fins, lightshelves, etc. The period for complete shading of direct sun is from March 21st though the summer until September 21st. Critical visual task spaces, include classrooms, gymnasiums and office spaces, but do not include copy rooms, storage areas, mechanical, laundry, and other low occupancy support areas, or spaces where the use of daylighting is deemed not appropriate.

Prerequisite 1.1. Daylighting is fundamentally important to high performance design, from the standpoint of student and teacher preference, and should be the primary source of illumination in classrooms.

To meet this requirement, 50% of the classrooms, gyms, office spaces, and other critical visual task spaces, as defined by the design team, must have a minimum DF of 2%. The DF is the ratio of horizontal exterior illumination under a standard overcast sky for the school's latitude to interior "task" illumination:

$$\text{Daylight Factor [\%]} = \frac{\text{Light at Task Levels in Classroom [fc or lux]}}{\text{Outdoor Daylight [fc or lux]}} \times 100$$

Follow the guidelines in the Daylighting Chapter of the *CHPS Best Practices Manual* to create a suitable daylighting strategy. Orient the school to maximize daylighting options. Do not overglaze the space. Daylighting in classrooms, gyms or offices must be uniformly distributed, with no direct-beam sunlight penetration and minimal glare. Direct sun must be eliminated for these daylit spaces with the use of fixed position shading devices such as various louvers, fins, and lightshelves, etc. The period for complete shading of direct sun is from March 21st though the summer until September 21st. Fixed or operable means of sun-glare control such as roll down perforated shades for the view windows and horizontal louvered blinds for the upper daylight windows must be specified for the period mid-September through mid March. The guidelines in the CHPS Daylighting Chapter thoroughly discuss several different approaches to classroom daylighting, including the use of clerestories, light shelves, and toplighting.

IEQ Credit 1: Daylighting in Classrooms

1 points *[Available for new construction ONLY]*	1.1. Achieve a 2% minimum daylight factor (DF) of uniformly distributed daylighting with no direct sunlight penetration to surfaces commonly visible from critical task areas. A DF of 2% must be available in **75%** of critical visual task spaces, to include classrooms, gymnasiums and office spaces, not including copy rooms, storage areas, mechanical, laundry, and other low occupancy support areas, or spaces where the use of daylighting is deemed not appropriate.
1 points *[Available for new construction ONLY]*	1.2. Achieve a 2% minimum daylight factor (DF) of uniformly distributed daylighting with no direct sunlight penetration to surfaces commonly visible from critical task areas. A DF of 2% must be available in **100%** of critical visual task spaces, to include classrooms, gymnasiums and office spaces, not including copy rooms, storage areas, mechanical, laundry, and other low occupancy support areas, or spaces where the use of daylighting is deemed not appropriate.
1 points *[Available for new construction ONLY]*	1.3. Provide a direct line of sight to vision glazing of no less than 40% visible light transmission (VLT) from 90% of the classrooms, administration areas, and all regularly occupied spaces, not including gymnasiums, performance spaces, computer labs, copy rooms, storage areas, mechanical, laundry and other low occupancy support areas.

Credit 1.1. To earn this credit, the same criteria apply as in P1.1 except **75%** of all classrooms, administration areas, and other regularly occupied spaces must conform to the daylight, and suncontrol requirements.

Credit 1.2. To earn this credit, the same criteria apply as in P1.1 except **100%** of all classroom, administration areas, and other regularly occupied spaces.

Credit 1.3. To fulfill this requirement 90% of all classroom, administration areas, and other regularly occupied spaces must contain direct line of sight glazing to the outdoors. Windows below 2.5 ft or above 7.5 ft do not qualify.

Resources
CHPS Best Practices Manual: Volume II: Daylighting and Fenestration Design Chapter.

LEED™ Reference Guide: Indoor Environmental Quality Credit 8: Daylighting.

Lighting Quality

Purpose: Promote improved visual performance through a high-efficacy, glare-free ambient lighting strategy.

IEQ Credit 2: Classroom/Library Lighting

1 point	2.1. Install electric lighting system to enhance the occupant's visual performance with pendant-mounted direct-indirect or semi-indirect luminaires mounted parallel to the window wall. Luminaires shall use high-lumen output ("Super") T8 or T5 fluorescent lamps with a minimum color-rendering index of 80. Lighting system to have daylight responsive controls. Lighting of task areas (chalkboard/whiteboards) can be supplemented with luminaires with a minimum initial system efficacy of 60 lumens per watt and controlled separately from general luminaires by occupancy sensors with or without dimmers.

Progressive learning institutions are rapidly moving to better prepare students for today's high-tech, postindustrial world. Many new forms of learning have gained acceptance, as emerging technologies enhance the quality and efficiency of information delivery.

But these varied media – including video, large-screen interactive presentations, and networked computer access to images and data – place new demands on the physical space. K-12 classrooms must be adaptable to support widely varying media and learning activities.

The more that teachers teach and students learn by the glow of computers and video screens, the more critical the need for high-quality, adjustable-level lighting. The quality and quantity of light directly affect learning performance and the visual comfort of both student and instructor.

Glare-free ambient lighting provides an excellent visual environment for which students and teachers to read, write, and interact with their peers. Pendant-mounted direct-indirect and semi-indirect luminaires offer low-brightness while providing good definition of objects in the space.

This design approach is very energy efficient using high-lumen output "Super" T8 fluorescent lamps and program start electronic ballasts. This type of T8 lamp is readily available through all of the major lamp manufacturers and offers higher light output per watt than standard T8 lamps. They also have better lumen maintenance over the life of the lamp.

T5 fluorescent lamps and electronic ballasts, also a good option, have an even higher lumen output than the "Super" T8's with a smaller envelope, allowing for a better performing optic system in the luminaires. Both provide good color quality so that all of the brightly colored projects on the walls show their best.

In many cases, chalkboard/whiteboard lighting is not needed. When it is used, a high-efficacy fluorescent wall-wash luminaire provides efficient illumination and enhances the visual quality of the space.

Energy efficient, direct-indirect lighting reduces the lighting power density (LPD) directly by using less energy to deliver a better quality of light to the space. The recommended approach is to install three rows of "Super" T8 two-lamp suspended direct/indirect luminaires in a typical classroom. This will provide the recommended light levels needed. In the case of T5 systems, the recommended approach is to install three rows of T5 single-lamp suspended direct/indirect luminaires.

Care must be taken to integrate the daylight so that the electric lighting is reduced or turned off when natural light levels are adequate. Daylight responsive sensors must be placed correctly to read the available daylight in the space. Spaces can appear "dreary" because of this approach of light. The contrast between a daylit area and interior space with low ambient lighting levels can also impact the visual quality of the space. Contrast can be managed by interior color selection, vertical surface illumination and the arrangement of the desks with respect to available daylight.

Resources
Advanced Lighting Guidelines: 2003 Edition, http://www.newbuildings.org/lighting.htm.

Indoor Air Quality

Purpose: Achieve superior indoor air quality to protect student and staff health, performance, and attendance.

IEQ Prerequisite 2: Minimum Requirements

Required	P2.1. Meet the performance requirements of Washington Minimum Ventilation Standard, including: Design building ventilation systems to ensure that the continuous delivery of outside air is no less than the governing design standard; ***AND*** will occur at all times rooms are occupied. The design must ensure that the supply operates in continuous mode and is not readily defeated (i.e., blocked registers or windows) during occupancy periods.
Required	P2.2. Meet the minimum requirements of voluntary consensus standard *ASHRAE 62-2001, Ventilation for Acceptable Indoor Air Quality* for areas not covered by Washington Minimum Ventilation Standard.
Required	P2.3. All surface grades, drainage systems, and HVAC condensate must be designed to prevent the accumulation of water under, in, or near buildings (especially portables).
Required	P2.4. Irrigation systems must not spray on buildings.
Required	P2.5. During construction, meet or exceed all of the following minimum requirements: ▪ Mold protection: Building materials, especially those like wood, porous insulation, paper, and fabric, and other porous materials must be kept dry before, during, and after installation to prevent the growth of mold and bacteria. Before installation, store all materials protected from the weather if possible. If stored outside, cover with plastic to protect from the rain and keep supported off of the ground. Immediately discard all water-damaged materials and replace with new, undamaged materials. ▪ Temporary filters: If air handlers must be used during construction, install filtration media with a Minimum Efficiency Reporting Value (MERV) of 8, as determined by *ASHRAE 52.2-1999*, at each return air grille. ▪ Permanent filters: Replace all filtration media immediately prior to occupancy. Filtration media shall have a Minimum Efficiency Reporting Value (MERV) of 13 as determined by *ASHRAE 52.2-2001* or the highest efficiency filter recommended by the manufacturer.

Supplying non-polluted outdoor air ventilation to classroom areas is critical to the protection of good indoor air quality. Ensure that the ventilation system's outdoor air capacity can meet the reference standards in all modes of operation. Locate building outdoor air intakes away from building exhausts, loading areas, building exhaust fans, cooling towers, and other sources of contamination. In addition, consider both current and future traffic and development patterns and consult the local Air Pollution Control Officer to locate nearby emission sources. Local air quality may impact decisions to use natural ventilation or may justify improved air filtration.

However, merely complying with code minimums during design and installation will not ensure good indoor air quality. It is also critical to use low-emitting materials (IEQ Credit 2), control the sources of indoor pollution (Credit 3), take protective measures during construction (IEQ Credit 4), commission the equipment (Energy Credit 4), and perform regular maintenance during occupancy.

P2.1. All regularly occupied spaces must be ventilated. Washington requires that the HVAC shall be operated continuously during working hours except:

- During scheduled maintenance and emergency repairs.
- During periods not exceeding a total of 90 hours per calendar year when a serving electric utility by contractual arrangement requests its customers to decrease electrical power demand.
- During periods for which the employer can demonstrate that the quantity of outdoor air supplied by non-mechanical means meets the outdoor air supply rate required by the code.

The Washington requirements are available at http://www.wa.gov/.

P2.2. For areas not covered Washington, ventilation systems must meet the minimum requirements of voluntary consensus standard *ASHRAE 62-2001, Ventilation for Acceptable Indoor Air Quality*.

P2.3. Due to extreme health risks that can be caused by mold and microbial growth, all surface grades, drainage systems, and HVAC condensate must be designed to prevent the accumulation of water under, in, or near buildings. Portables are particularly vulnerable, and must be placed on properly drained surfaces.

P2.4. Permanent irrigation systems that spray on buildings can cause major structural damage and mold growth. Do not install irrigation systems in locations where they spray directly on buildings.

P2.5. Construction activities affect indoor air quality. Mold protection and filtration are prerequisites; additional measures are covered under IEQ Credit 4.

Resources
ASHRAE 62-2001, Ventilation for Acceptable Indoor Air Quality, http://www.ashrae.org/.

Washington State Energy Code, http://www.wa.gov/.

IEQ Credit 3: Low-Emitting Materials (Interior Use)

1 to 4 points	3.1. Receive one point (up to a maximum of four points) for each of the following products complying with the listed protocols. ▪ Interior adhesives, sealants, and concrete sealers (South Coast Air Quality Management District, SCAQMD, Rule 1168). ▪ Interior carpet, resilient flooring (Carpet and Rug Institute Green Label Indoor Air Quality Test Program). ▪ Interior paint (Green Seal GS-11 Standard). ▪ Building insulation (Greenguard™ or specified as no added urea-formaldehyde resins). ▪ Acoustical ceilings or wall panels (Greenguard™). ▪ Interior wood flooring and composite wood products (specify no added urea-formaldehyde resins).
1 point	3.2. Use furniture systems and seating that are low VOC, either Greenguard™ certified or registered or whose emissions meet or are lower than the best practice air emissions standards as established by the US EPA's Environmental Technology Verification (ETV) test method in a qualified testing laboratory.

Many common indoor building and surfacing materials contain a variety of carcinogenic and/or toxic chemicals. These chemicals are released into the air and can cause a variety of heath problems, from irritating odors to major health problems. Because a single material can off-gas enough toxins to cause health problems, it is important to evaluate and specify materials that are low emitting, non-irritating, nontoxic, and chemically inert. This is especially important in schools because children are more susceptible than adults to indoor air pollutants.

Credit 3.1. CHPS has developed sample material specifications to identify materials that will not compromise the health of students and staff. The CHPS material specifications (available from http://www.chps.net/) identify over 60 specific chemicals that have been found to impact human health and the maximum emission levels for each. Designers should request emissions test data from manufacturers to ensure that the chemical emissions are within safe exposure levels, or look for products that have been certified by a third party or otherwise indicate the standards they meet.

Credit 3.2. Use systems furniture and office seating that is Greenguard™ certified or registered.

OR

Use systems furniture and office seating whose emissions meet or are lower than the best practice air emissions standards as established by the US EPA's Environmental Technology Verification (ETV) test method in a qualified testing laboratory. The following emission levels must be reached within one week (seven days) of unpacking the product and installation in a building.

Emission Limits for Furniture Systems:

- TVOC's <0.5 mg/m^3
- Formaldehyde <0.05 ppm
- Total Aldehydes <0.1 ppm
- 4-PC (as an odorant) below the limits of detection

Emission Limits for Office Seating:

- TVOC's <0.25 mg/m^3
- Formaldehyde <0.025 ppm

- Total Aldehydes <0.05 ppm
- 4-PC (as an odorant) below the limits of detection

Resources

Collaborative for High Performance Schools, http://www.chps.net/.

Green Seal Standard GS-11, Paints. Online at http://www.greenseal.org/standards/paints.htm.

Greenguard Product Directory, online at http://www.greenguard.org/products/productguide.asp.

LEED™ Reference Guide: Indoor Environmental Quality Credit 4: Low-Emitting Materials.

LEED™ Rating System for Commercial Interiors Pilot Draft, Indoor Environmental Quality Credit 4: Low-Emitting Materials.

IEQ Credit 4: Pollutant Source Control

1 point	4.1. Design to minimize cross-contamination of regularly occupied areas by chemical pollutants: Control surface dust by covering all exposed dirt, providing walk-off mats at all entrances, and avoiding use of deep-pile carpets; ***AND*** where chemical use occurs (including housekeeping areas, chemical mixing areas, copying/print rooms), use structural deck-to-deck partitions with separate outside exhausting, no air recirculation, and negative pressure; ***AND*** install low-noise, vented range hoods for all cooking appliances (such as stoves, ovens) and chemical mixing areas in lab or prep spaces; ***AND*** provide drains with plumbing appropriate for disposal of liquid waste in spaces where water and chemical concentrate mixing occurs.
1 point	4.2. Install ducted HVAC returns to avoid the dust and microbial growth issues associated with plenum returns.
1 point	4.3. Use particle arrestance filtration rated at greater than 65% in all mechanical ventilation systems.

Credit 4.1. Design to physically isolate activities associated with chemical contaminants from other sources of the building, and provide dedicated systems to contain and remove chemical pollutants at their source locations. Eliminate or isolate high hazard areas and design all housekeeping chemical storage and mixing areas (central storage facilities and janitors closets) to allow for secure product storage. Design copy/fax/printer/printing rooms with structural deck-to-deck partitions and dedicated exhaust ventilation systems.

Credit 4.2. Plenum returns are easily contaminated with dust and microbial growth. Ducted returns, though more expensive, will help prevent such problems and reduce maintenance and repairs.

Credit 4.3. Filters rated at greater than 65% will remove more pollutants from the air used to ventilate the school.

IEQ Credit 5: Construction IAQ Management Plan

1 point	5.1. During construction, meet or exceed all of the following minimum requirements: ▪ Temporary construction ventilation: Continuously ventilate affected spaces during installation of materials that emit volatile organic compounds (VOC) and for at least 72 hours after installation. Ventilate longer than 72 hours if necessary to completely remove odors. Exhaust the air directly to the outside; do not recirculate to other enclosed spaces. If continuous ventilation is not possible using the building's HVAC system or temporary ventilation, then ventilate via open windows and temporary fans. ▪ Duct protection: Turn the ventilation system off, and protect HVAC supply and return openings from debris generated during dust-producing activities such as drywall installation and finishing. Provide temporary ventilation as required. ▪ Preconditioning: Allow products with odors and significant VOC content to off-gas off-site in dry, well-ventilated space for at least two weeks prior to delivery to the construction site. Remove products from their containers and packaging to maximize off gassing of VOCs. ▪ Sequencing: Install odorous and/or VOC-emitting products prior to installation of porous and fibrous materials. ▪ HEPA vacuuming (carpets and upholstery): After installation, vacuum carpeted and soft surfaces with a high-efficiency particulate arrestor (HEPA) vacuum as needed and just prior to occupancy. ▪ HEPA duct cleaning: Prior to installation, inspect ducting for dust and to confirm that the oil film has been completely removed. Remove any dust, dirt, and remaining oil. Prior to substantial completion and prior to using the system, inspect the ducts again for dust and other debris that may have collected during construction. Immediately remove any dust using a HEPA vacuum.
1 point	5.2. Flush the building continuously, 24 hours per day, using 100% tempered outside air for at least two weeks after construction and before the building is occupied. If the contractor is required to perform touch-up work during this time, provide temporary construction ventilation during the work and extend the building flush out by a minimum of four days after touch-up installation.

Credit 5.1. Each of the listed construction practices will improve indoor air quality by minimizing the amount of indoor pollutants that are distributed and retained by the surface materials and ventilation systems during construction.

Credit 5.2. Flushing out the building with 100% outside air will help remove indoor pollutants prior to occupancy. Do not "bake out" the building by increasing the temperature of the space.

Resources
CHPS Best Practices Manual, Volume II: Guideline GC3: Indoor Air Quality During Construction.

LEED™ Rating System for Commercial Interiors Pilot Draft, Indoor Environmental Quality Credit 3: Indoor Air Quality Management.

SMACNA IAQ Guideline for Occupied Buildings under Construction, 1995, Chapter 3.

Acoustics

Purpose: Design HVAC systems and classrooms to provide acoustic levels that do not interfere with student and teacher productivity.

IEQ Prerequisite 3: Minimum Acoustical Performance

Required	P3.1. Classrooms must have: ▪ Maximum unoccupied background noise levels of 50 NC. ▪ 0.6-second maximum (unoccupied) reverberation times.

Excess noise from exterior sources, loud HVAC systems, or other nearby rooms can make it difficult, and sometimes impossible, for students to learn and for teachers to communicate.

The purpose of this prerequisite is to eliminate the worst performing acoustical environments. However, even background noise levels of 50 NC are too noisy for young children, students with limited English proficiency, and those with hearing impairments or language disorders. **Districts and designers are strongly encouraged to move beyond these prerequisites and achieve background noise levels of 30 NC for all classrooms.** (See IEQ Credit 6.)

Important aspects of classroom acoustical design include isolation from exterior noise (wind loads, traffic and other loud outdoor activities), elimination of interior noise (from HVAC systems, foot traffic and other classrooms), and the use of appropriate wall assembly and interior surface materials to minimize sound propagation and reduce reverberation times in the classrooms. The most common sources of interior mechanical noise are the air conditioning and air-handling components, including ducts, fans, condensers, and dampers.

Architects and engineers must design to these levels. Verification should be integrated with building commissioning.

Resources
National Clearinghouse for Educational Facilities, http://www.edfacilities.org/.

IEQ Credit 6: Improved Acoustical Performance

1 point	6.1. Classrooms must have: ▪ 35 NC maximum (unoccupied) background noise levels. ▪ 0.6-second maximum (unoccupied) reverberation times.
1 point	6.2. Classrooms reducing the unoccupied background noise levels by an additional 5 NC (for a 30 NC maximum), with a 0.6-second maximum (unoccupied) reverberation times.

Acousticians recommend 30 NC as the minimum background levels for school classrooms. Strategies for improving the background noise levels include using centralized HVAC systems and acoustically isolating mechanical equipment from classrooms.

Resources
National Clearinghouse for Educational Facilities, http://www.edfacilities.org/.

Thermal Comfort

Purpose: Provide level thermal comfort with individual teacher control of thermal, ventilation, and lighting systems to support optimum health, productivity, and comfort.

IEQ Prerequisite 4: *ASHRAE 55* Code Compliance

Required	P4.1. Comply with *ASHRAE Standard 55-1992, Addenda 1995* for thermal comfort standards, including humidity control within established ranges per climate zone. Indoor design temperature and humidity conditions for general comfort applications shall be determined in accordance with *ANSI/ASHRAE 55-1992* or Chapter 8 of the *ASHRAE Handbook, 1993, Fundamentals* volume. Note that winter humidification and summer dehumidification shall not be required. The upper limit may be ignored for naturally ventilated buildings.

Resources
ASHRAE Standard 55-1992, http://www.ashrae.org/.

CHPS Best Practices Manual, Volume II: HVAC Chapter.

IEQ Credit 7: Controllability of Systems

1 point	7.1. Provide a minimum of one operable window in each classroom.
1 point	7.2. Provide temperature and lighting controls for each classroom.

Credit 7.1. Operable windows are important for personal comfort and have been shown to improve student performance. Provide at least one operable window in each classroom. It is recommended to interlock controls with the HVAC system to optimize energy efficiency. Train teachers on how to properly use the HVAC controls in their rooms and how opening door and windows affect ventilation and comfort.

Credit 7.2. Individual classrooms will vary in temperature depending on their orientation and other building conditions, as well as occupant preferences. Provide individual or integrated controls systems to allow teachers to regulate the lighting and temperature of their classrooms.

IEQ Credit 8: Natural Cooling

3 point	8.1. Design 90% of permanent classrooms without air conditioning.

Credit 8.1. According to a study by the American Lung Association, North Americans spent 50% of their time indoors in the 1950s. By the 1990s, we were spending 90% of our time in comfort-controlled environments. Technology has played a role in bringing us indoors by making buildings more productive for teachers, comfortable for students, and created more efficient building plan forms (but not necessarily more energy efficient or comfortable).

Prior to air conditioning, school buildings required natural ventilation and cooling. This defined the shape of the building as each office or room required an operable window. The T, H, or L-shaped floor plans, which allowed the maximum number of windows to provide natural light and ventilation, are still visible in most cities.

Sunlight and solar gain are major influences on buildings in mid to late afternoon when students typically are not present. This allows designers to minimize solar gains to keep students comfortable in non-air conditioned buildings by properly orienting and shading windows.

It is critically important to verify that required ventilation levels can be maintained through natural ventilation, and that no outdoor pollutants (from traffic, industrial sources, or the potential for air quality emergencies) eliminate its feasibility. To meet ASHRAE ventilation standards, all occupants must be within 20 feet of an operable window. For a standard classroom, this would require that operable windows be installed on both sides. If this design is not possible, ventilation systems with exhaust fans would need to be installed to provide the minimum required ventilation levels. In-line fans designed for radon removal provide one low-power option.

Air conditioning systems prohibited by this credit include air- and water-source packaged air conditioners or heat pumps. Direct/indirect evaporative systems without compressed refrigerant can be used and still receive this credit.

Resources
CHPS Best Practices Manual, Volume II: Guideline TC1: Cross Ventilation; Guideline TC2: Stack Ventilation; Guideline TC3: Ceiling Fans.

EXTRA CREDIT

District Level

Purpose: To recognize the efforts of individual projects that expand the impact of the project to other schools in the district by integrating high performance practices into policy or planning at the district level.

Extra Credit 1: District Level Innovations

1 point	1.1. District-wide high performance policy. District must formally adopt a resolution or operating policy that integrates high performance standards in the preparation and revision of district educational specifications and building programs, i.e., requiring all new facilities to be high performance schools or prioritizing CHPS Schools in local bond funding.
1-3 points	1.2. Receive one point (up to a maximum of three) for instigating district-level policies and practices during the course of a project that not only support the project's high performance goals but also broaden their impact to future projects.

An innovation credit is a vehicle by which Washington Sustainable Schools can recognize efforts that exceed and/or significantly enhance or are different from existing credits. Awarding innovation credits encourages districts to continually develop their skills and experiences with high performance buildings.

Credit 1.1. Districts leaders who institutionalize high performance are not just building better schools; they are protecting student health, improving test scores, and lowering the district's operating expenses. To earn this credit, the district must formally adopt resolutions or operational policies that reference compliance with the Washington Sustainable Schools Protocol. The district is free to decide the most appropriate way to integrate the protocol into their specifications and building program. Some districts may take an aggressive leadership role and require that all new schools comply with the Washington Sustainable Schools Criteria. Others may use a phased approach: starting with several pilot schools and gradually requiring all schools to comply. Other options include offering additional funds or priority funding in local bond elections. Adding requirements for only specific issues (such as daylighting or energy efficiency) are positive steps but do not qualify for this point. The intent is to recognize formulation of a comprehensive policy requiring high performance school design and construction in the district.

Credit 1.2.

Maintenance Plan. The district must create a school maintenance plan that includes an inventory of all equipment in the school and their preventative maintenance needs. Regular maintenance is critically important to the operation and performance of schools.

District Level Transportation. Provide bus service for students or alternative fueling, e.g., at least 20% of the district-owned buses and maintenance vehicles serving the school must use alternative fuels. If district bus service is provided under contract from a third party, then 20% of the buses used to service the school must use alternative fuels.

ENERGYSTAR®-compliant Equipment Purchasing Resolution. Pass a district wide resolution to purchase high efficiency equipment and appliances and prohibit the purchase of low efficiency products such as halogen torchieres and portable electric resistance heaters.

Green Power. Sign up to participate in renewable power purchasing programs from the local utility.

IAQ Management Plan. Implement the EPA's Tools for Schools Program or an alternative, equivalent in scope and effectiveness. Include the plan in the Facility Maintenance and Commissioning Plans.

Integrated Pest Management (IPM) Program. Develop and implement a formal IPM Program for school facilities and prohibit the use of any product on Tier I of the "King County Pesticide Tier Table."

Green Cleaning Purchasing Program. Develop and implement a formal green cleaning purchasing program for the district that meets or exceeds the environmental criteria listed in the State of Washington's Environmentally Responsible Cleaning Products Contract #11399, Attachment VI, or such that vendors are required to submit either Green Seal certification or specific test results to document that they meet the environmental criteria required in the *Massachusetts RFR #GR016 for Cleaning Products, Environmentally Preferable*.

Low Environmental Impact Disposable Product Purchasing Program. Develop and maintain a formal, district-level policy of low environmental impact disposable product purchasing program that includes:

- Use of disposable paper products using 100% recycled content, with a minimum of 30% post consumer recycled content and manufactured without the additional use of elemental chlorine or chlorine compounds;
- ***AND*** use plastic liners for trashcans and other receptacles with a minimum of 30% post consumer recycled content.

Resources
Massachusetts RFR #GR016 for Cleaning Products, Environmentally Preferable, http://www.newdream.org/procure/products/MassRFP.pdf.

Project Level

Purpose: To recognize design teams for including innovative high performance features in their school building(s), and to summarize their learning for application in future projects.

Extra Credit 2: Project Level Innovation

1 point	2.1. Environmental Education. Develop student learning opportunities highlighting the environmentally sensitive aspects of the building structure and site, through exposed systems, lesson plans, teaching aids and signage.
1–3 points	2.2. Receive one point (with a maximum of three) for additional project level innovations. Write a description of the purpose or intent the proposed credit, any standards required to meet the proposed credit, the strategies used to meet the credit, recommended references, and any relevant evidence of performance achieved.

The definition of a "High Performance School" is continuously evolving. New developments are constantly being introduced to improve the efficiency and effectiveness of schools.

An innovation credit is a vehicle by which Washington Sustainable Schools can recognize efforts that exceed and/or significantly enhance or are different from existing credits. Awarding innovation credits encourages districts to continually develop their skills and experiences with high performance buildings.

Credit 2.1. For existing schools, students can be involved in analyzing baseline energy conditions as well as planning and implementing outdoor classroom resources (e.g., gardens, native plants). For new schools, outdoor classrooms and learning environments should be planned into the site design for use or further development by students. Students could create signs, displays, newsletter articles or brochures to educate each other and visitors about the environmental design features that are included. Exposed building systems can be utilized as learning opportunities. To earn this credit, the project must, in addition to providing the opportunity and learning elements, provide teachers and staff with training and background information.

Credit 2.2. Ideas for Project Level Innovation Credits:

Variance Achieved. Project achieved a variance in district, local, or state regulations in order to implement a high performance or green strategy.

Lab Environmental Quality. Lab facilities are designed to address unique concerns related to special wastes, IEQ, and energy and water use.

Food Related Waste Prevention and Management. Project design addresses special handling options for food prep and related wastes (e.g., on-site/off-site composting, worm bins, on-site vegetable/herb gardens, etc.).

Transportation Options Program. Project developed/implemented a Transportation Options Program, with input from the local community and other stakeholders, to improve the school's connection to the community by offering students and staff more transportation choices – such as public buses, rail, biking and walking.

Professional Education. Develop and distribute a case study of the environmentally sensitive aspects of the project for use by school facility designers and district planners.

PROTOCOL SCORECARD

Site 16 points ✔

Site Selection	Prereq 1	Code Compliance	R	P1.1. Comply with all siting and environmental impact study requirements of *School Facilities Manual*.	
	Credit 1	Sustainable Site Selection	1	1.1. No development on sites that are: important agricultural land, in flood zone, habitat for endangered species, or within 100 feet of any wetland.	
			1	1.2. Do not build on greenfields.	
			1	1.3. Located sites where at least 50% of students live within minimum distances from the school.	
			1-2	1.4. Joint use of facilities; 1 pt for shared use; an additional point (total of 2 pts) if dedicated use.	
			1	1.5. Joint use of parks.	
			1-2	1.6. Minimize footprint; 1pt if is FAR at least 1.4; an additional point (total 2 pts) if FAR at least 1.6.	
Transportation	Credit 2	Transportation	1	2.1. Near public transit in urban areas; provide busing to the school in rural and suburban areas.	
			1	2.2. Provide bike lanes or sidewalks, and means for securing bicycles.	
			1	2.3. Minimize parking lot and create preferred parking for carpools or vanpools and alternative fuel vehicles.	
Stormwater Management	Prereq 2	Temporary Sedimentation and Erosion Control	R	P2.1. Design to a site sedimentation and erosion control plan intended to reduce negative impacts on water and air quality during construction.	
	Credit 3	Permanent Stormwater Management	1	3.1. Promote onsite infiltration.	
			1	3.2. Treat runoff or effectively reduce it to zero.	
Outdoor Surfaces	Credit 4	Landscape and Exterior Design to Reduce Heat Islands	1	4.1. Shade or lighten impervious areas, or reduce impervious parking.	
			1	4.2. Install cool roof or “green” vegetated roof.	
Outdoor Lighting	Credit 5	Light Pollution Reduction	1	5.1. Do not exceed IESNA RP-33 footcandle requirements. Minimize illumination with no direct beam leaving site.	

Water 6 Points ✔

Outdoor Systems	Prereq 1	Create Water Use Budget	R	P1.1. Develop and design to a landscape and ornamental water use budget.	
	Credit 1	Reduce Potable Water for Landscaping	1	1.1. Reduce potable and river or groundwater irrigation district water consumption for irrigation by 50% over landscape budget baseline.	
			1	1.2. Reduce potable water for irrigation by additional 50% (a total of 100% reduction) or do not install permanent landscape irrigation systems.	
			1	1.3. Create an irrigation commissioning plan (also known as a water audit plan).	
Indoor Systems	Credit 2	Water Use Reduction	1	2.1. Reduce use of municipally provided potable water for building sewage conveyance by a minimum of 45% beyond building baseline.	
			1	2.2. Reduce potable water use by at least 20% beyond building baseline.	
			1	2.3. Reduce potable water use by an additional 10% (a total reduction of at least 30%) beyond baseline.	

Materials 17 points ✔

Waste Reduction and Efficient Materials Use	Prereq 1	Storage and Collection of Recyclables	R	P1.1. Meet local ordinance requirements for recycling space and have accessible spaces dedicated to recycling.	
	Credit 1	Site Waste Management	1	1.1. Meet local ordinances, develop and implement waste management plan to recycle, compost, and/or salvage at least 50% construction, demolition and land clearing waste.	
			1	1.2. Meet local ordinances, develop and implement waste management plan to recycle, compost, and/or salvage an additional 25% (total of at least 75%) construction, demolition and land clearing waste.	
	Credit 2	Building Reuse	1	2.1. Maintain (reuse) at least 75% of previous structure and shell.	
			1	2.2. Maintain (reuse) an additional 25% (100% of total) of existing structure and shell.	
			1	2.3. Maintain (reuse) 100% of existing building and at least 50% of non-shell systems.	
	Credit 3	Resource Reuse	1	3.1. Install salvaged or refurbished materials for 5% of building materials.	
			1	3.2. Install an additional 5% of salvaged or refurbished materials (a total of at least 10% of building materials).	
			1	3.3. Install salvaged, refurbished, or used furniture and equipment for at least 30% of Furniture and Equipment budget	
Sustainable Materials	Credit 4	Recycled Content	1	4.1. Minimum of 5% of total value of materials (using calculation), or 4 major categories of building materials meet requirements.	
			1	4.2. An additional 5% (total of at least 10%) of total value of materials (using calculations), or 8 major categories of building materials meet requirements	
	Credit 5	Rapidly Renewable Materials	1	5.1. Install rapidly renewable building materials for 5% of total building materials.	
	Credit 6	Certified Wood	1	6.1. At least 20% of cost of wood-based materials and products are from sustainable forest certified by third party.	
			1	6.2. An additional 30% (total of 50%) of cost of wood-based materials and products are from sustainable forest certified by third party.	
			1	6.3. Third party certification offers chain of custody verification.	
	Credit 7	Eliminate Ozone-Depleting Substances	1	7.1. All new base building equipment must be free of HCFC and halons.	
	Credit 8	Regional/Local Materials	1	8.1. Install materials that are manufactured within a 500-mile radius for 20% of building materials.	
			1	8.2. Install materials from that are extracted, harvested or recovered from within a 500-mile radius for 20% of building materials.	

Energy 20 points ✔

Energy Efficiency	Prereq 1	Minimum Energy Performance	R	P1.1. Design building to meet Washington State's NREC efficiency standards.	
	Credit 1	Superior Energy Performance	4-12	1.1. 10% (4 pts) to 50% (12 pts) reduction in total net energy use from NREC baseline, **OR** include all prescriptive criteria (4 pts) including Bi-Level Lighting Controls, Automatic Lighting Reduction, Best Practices Mechanical System Design, Opaque Envelope Performance, Window Performance, Skylight Performance, Cool Roof, Mechanical Efficiency, Variable Air Volume, Lighting Power Density, and Daylight Responsive Controls.	
	Credit 2	HVAC and Operable Windows	1	2.1. Install controls/devices for HVAC that respond to operable windows or open doors.	
Alternative Energy Sources	Credit 3	Renewable Energy and Distributed Generation	1-4	3.1. 5% to 10% of net building system's energy use supplied by renewable energy or distributed generation.	
Commissioning and Verification	Prereq 2	Fundamental Building Systems Testing and Training	R	P2.1. Comply with requirements of Section 1416, Washington. NREC and WAC 180-27-08 regarding drawings, manuals, system balancing, system commissioning.	
	Credit 4	Commissioning	1	4.1. Develop a joint statement of project goals and principles through a facilitated discussion BEFORE the design development begins.	
			1	4.2. Hire a commissioning agent (CxA), independent of the design and construction management team, to provide commissioning services.	
	Credit 5	Energy Management Systems	1	5.1. Install an energy management system to measure and control loads for lighting, equipment, HVAC, hot water.	

IEQ 21 points ✔

Daylighting	Prereq 1	Daylighting in Classrooms	R	P1.1. Minimum 2% daylight factor in 50% of critical tasks (new construction only). (3 pts for renovation only.)	
	Credit 1	Daylighting in Classrooms (new construction only)	1	1.1. Minimum 2% daylight factor in 75% of critical tasks.	
			1	1.2. Minimum 2% daylight factor in 100% of critical tasks.	
			1	1.3. Direct line of sight for 90% of classrooms.	
Lighting Quality	Credit 2	Classroom/Library Lighting	1	2.1 Pendant mounted indirect/direct or semi-indirect luminaires with high-lumen T8 or T5 lamps.	
Indoor Air Quality	Prereq 2	Minimum Requirements	R	P2.1. HVAC must meet Washington Minimum Ventilation Standard.	
				P2.2. Meet the minimum requirements of *ASHRAE 62-2001*.	
				P2.3. All surface grades, drainage systems, and HVAC condensate must be designed to prevent the accumulation of water under, in, or near buildings (especially portables).	
				P2.4. Irrigation systems must not spray on buildings.	
				P2.5. Meet or exceed the minimum requirements for mold protection, temporary filters, and permanent filters.	
	Credit 3	Low-Emitting Materials (Interior Use)	1-4	3.1. Building materials (paints, ceiling tiles, carpet, adhesives, etc.) comply with given protocols.	
			1	3.2. Use low emitting furniture systems and seating.	
	Credit 4	Pollutant Source Control	1	4.1. Control dust, segregate pollutant sources, local exhaust in kitchens and labs, appropriately plumbed drains in chemical storage areas.	
			1	4.2. Install ducted HVAC returns.	
			1	4.3. Use particle arrestance filtration rated at greater than 65%.	
	Credit 5	Construction IAQ Management Plan	1	5.1. Create and implement specified construction IAQ plan.	
			1	5.2. Flush out building continuously, 24 hours a day, for at least 2 weeks after construction and before the building is occupied.	
Acoustics	Prereq 3	Minimum Acoustical Performance	R	P3.1. Classrooms must have a maximum (unoccupied) noise level of 50 NC, with maximum (unoccupied) reverberation times of 0.6 sec.	
	Credit 6	Improved Acoustical Performance	1	6.1. Classrooms must have a maximum (unoccupied) noise level of 35 NC, with maximum (unoccupied) reverberation times of 0.6 sec.	
			1	6.2. Classrooms with an additional 5 NC reduction in unoccupied noise level (resulting in maximum of 30 NC), with maximum (unoccupied) reverberation times of 0.6 sec.	
Thermal Comfort	Prereq 4	*ASHRAE 55* Code Compliance	R	P4.1. Comply with *ASHRAE 55-1992* thermal comfort standard.	
	Credit 7	Controllability of Systems	1	7.1. Provide a minimum of one operable window in each classroom.	
			1	7.2. Provide temperature and multi-level lighting controls for each classroom.	
	Credit 8	Natural Cooling	3	8.1. Design 90% of permanent classrooms without air conditioning.	

Extra Credit 8 points ✔

District Level	Credit 1	District Level Innovations	1	1.1. Formally adopt resolution or policy integrating high performance standards into district educational specifications and building programs.	
			1-3	1.2. Receive 1 pt (up to max of 3 pts) for instigating district-level policies and practices to support a project's high performance goals.	
Project Level	Credit 2	Project Level Innovations	1	2.1 Develop student learning opportunities highlighting environmentally sensitive aspects of building and site design.	
			1-3	2.2 Receive 1 pt (with max of 3 pts) for additional project level innovations.	

Minimum total required for CHPS School (Four points must be in Energy category with a maximum of four points in Extra Credit Category. 38

APPENDIX -- SUPERIOR ENERGY

Table 1a – Minimum Insulation Requirement R-values

Climate Zone	Coastal WA	Inland WA
Roofs		
Insulation Entirely above Deck	R-30 ci	R-30 ci
Metal Buildings (with R-5 thermal blocks[1])	R-19 || + R-13	R-19 || + R-13
Attic and Other[2,3]	R-38[2]	R-38[2, 3]
Walls, Above Grade		
Mass, exterior insulation	R-7.6 ci	R-11.5 ci
Mass, interior insulation	R-13	R-13
Metal Building	R-10 + R-13	R-10 + R-13
Metal Framed	R-13 + R-5 ci	R-13 + R-5 ci
Wood Framed and Other	R-19	R-19
Walls, Below Grade		
Mass, exterior insulation	R-7.5 ci [4]	R-7.5 ci [4]
Mass, interior insulation	R-19	R-19
Floors		
Mass	R-10 ci	R-10 ci
Metal Joist	R-30	R-30
Wood Joist/Framing	R-30	R-30
Slab-on-Grade Floors		
Unheated Slabs	R-10 for 24 in.	R-10 for 24 in.
Heated Slabs	R-10 for 24 in. + R-5 ci below	R-15 for 36 in. + R-5 ci below
Opaque Doors		
Swinging	U – 0.61	U – 0.37
Roll-up or Sliding	R-4.75	R-4.75

ci – continuous insulation

[1] Thermal blocks are an R-5 of rigid insulation, which extends 1" beyond the width of the purlin on each side, perpendicular to the purlin.

[2] Where vapor permeable insulation is used in the Washington climates, the temperature of any condensation plane should be kept above the dew point of the internal air, as described in the text above.

[3] In any attic-type space, where insulation is blown or sprayed into the cavity, an additional R-11 of insulation is required in the inland Washington climate.

[4] When heated slabs are placed below grade, below grade walls must meet the exterior insulation requirements for perimeter insulation according to the heated Slab-On-Grade construction.

Table 1b – Maximum Insulation U-factors, C-factors, and F-factors

Climate Zone	Coastal WA	Inland WA
Roofs		
Insulation Entirely above Deck	U – 0.039	U – 0.039
Metal Buildings (with R-5 thermal blocks[1])	U – 0.041	U – 0.041
Attic and Other [2, 3]	U – 0.034 [2]	U – 0.034 [2, 3]
Walls, Above Grade		
Mass, exterior insulation	U – 0.100	U – 0.072
Mass, interior insulation	U – 0.113	U – 0.113
Metal Building	U – 0.063	U – 0.063
Metal Framed	U – 0.077	U – 0.077
Wood Framed and Other	U – 0.060	U – 0.060
Walls, Below Grade		
Mass, exterior insulation	C – 0.119	C – 0.119
Mass, interior insulation	C – 0.125	C – 0.125
Floors		
Mass	U – 0.076	U – 0.076
Metal Joist	U – 0.038	U – 0.038
Wood Joist / Wood Frame	U – 0.033	U – 0.033
Slab-on-Grade Floors		
Unheated Slabs	F – 0.54	F – 0.54
Heated Slabs	F – 0.55	F – 0.44
Opaque Doors		
Swinging	U – 0.61	U – 0.37
Roll-up or Sliding	U – 0.53	U – 0.53

[1] Thermal blocks are an R-5 of rigid insulation, which extends 1" beyond the width of the purlin on each side, perpendicular to the purlin.
[2] Where vapor permeable insulation is used in the Washington climates, the temperature of any condensation plane should be kept above the dew point of the internal air, as described in the text above.
[3] In any attic-type space, where insulation is blown or sprayed into the cavity, an additional R-11 of insulation is required in the inland Washington climate.

Table 2 – Windows

Climate Zone	Coastal WA	Inland WA
Factory Assembled Fenestration Product U-Factor	0.35	0.35
SHGC: Any PF	0.40	0.40
Site Assembled Product U-Factor	0.40	0.40
SHGC: PF < 0.25	0.24	0.30
SHGC: 0.25<PF<0.5	0.32	0.39
SHGC: PF > 0.5	0.39	0.39
VLT/SHGC Ratio (*Daylight glazing* only)	> 1.5	> 1.5

SHGC=Solar Heat Gain Coefficient PF= Projection Factor VLT=Visible Light Transmittance

Fenestration

Window Criteria Advisory:

Please note that the following commercial/site built window constructions are representative types to meet the Guidelines criteria and are not recommendations for any specific construction project.

U-factor = Representation window construction

0.35 = Double low-e w/vinyl frame

0.49 = Double low-e w/thermal break

0.57 = Double low-e w/aluminum frame

0.73 = Double w/ aluminum

1.22 = Single aluminum

.40 = Double low-e/argon/thermally improved

Table 3 – Skylights

Climate Zone	Coastal WA	Inland WA
Factory Assembled Fenestration Products		
U-Factor	0.45	0.45
SHGC	0.40	0.40
Glass, no curb		
U-factor	0.57	0.54
SHGC	0.32	0.36
VLT/SHGC Ratio	> 1.25	> 1.25
Glass, with curb		
U-factor	0.71	0.67
SHGC	0.32	0.36
VLT/SHGC Ratio	> 1.25	> 1.25
Plastic, with curb		
U-factor	1.12	1.12
SHGC	0.34	0.34
VLT/SHGC Ratio	> 1.1	> 1.1

Skylight Criteria Advisory:

Please note that the following skylight constructions are representative types to meet the Guidelines criteria and are not recommendations for any specific construction project.

U-factor = Representation skylight construction (glass)

0.57/0.71= Double low-e w/thermal break
with an SHGC of:
- 19= High Performance Tint and Medium Reflective Coating
- 32= High Performance Tint
- 36= Green Tint
- 46= Clear

0.68/0.83= Double low-e w/aluminum frame
with an SHGC of:
- 0.39= Green Tint

U-factor = Representation skylight construction (plastic)

1.29= Double w/aluminum frame
with an SHGC of:
- 0.34= Low white
- 0.54= Medium white

1.12= Double w/thermal break
with an SHGC of:
- 0.40= Low white

0.91= Triple w/thermal break
with an SHGC of:
- 0.59= High white

Table 4 - Unitary Air Conditioners and Condensing Units, Electrically Operated

Equipment Type	Size Category	Sub-Category or Rating Condition	Required Efficiency
Air Conditioners, Air Cooled	< 65,000 Btu/h	Split System	13.0 SEER
		Single Package	13.0 SEER
	≥65,000 Btu/h and < 135,000 Btu/h	Split System and Single Package	11.0 EER 11.4 IPLV
	≥135,000 Btu/h and < 240,000 Btu/h	Split System and Single Package	10.8 EER 11.2 IPLV
	≥ 240,000 Btu/h and <760,000 Btu/h	Split System and Single Package	10.0 EER 10.4 IPLV
Air Conditioners, Water and Evaporatively Cooled	All Sizes	Split System and Single Package	14.0 EER
Source :Consortium for Energy Efficiency, http://www.cee1.org/com/hecac/hecac-main.php3.			

Table 5 - Unitary and Applied Heat Pumps, Electrically Operated

Equipment Type	Size Category	Sub-Category or Rating Condition	Required Efficiency
Air Cooled, (Cooling Mode)	< 65,000 Btu/h	Split System	13.0 SEER
		Single Package	13.0 SEER
	≥65,000 Btu/h and < 135,000 Btu/h	Split System and Single Package	11.0 EER 11.4 IPLV
	≥135,000 Btu/h and <240,000 Btu/h	Split System and Single Package	10.8 EER 11.2 IPLV
	≥240,000 Btu/h	Split System and Single Package	10.0 EER 10.4 IPLV
Air Cooled (Heating Mode)	< 65,000 Btu/h (Cooling Capacity)	Split System	8.0 HSPF
		Single Package	7.7 HSPF
	≥65,000 Btu/h and < 135,000 Btu/h (Cooling Capacity)	47°F db/43°F wb Outdoor Air	3.4 COP
		17°F db/15°F wb Outdoor Air	2.4 COP
	≥135,000 Btu/h (Cooling Capacity)	47°F db/43°F wb Outdoor Air	3.3 COP
		17°F db/15°F wb Outdoor Air	2.2 COP
Water Source (Cooling Mode)	< 135,000 Btu/h (Cooling Capacity)	85°F Entering Water	14.0 EER
Water-Source (Heating Mode)	< 135,000 Btu/h (Cooling Capacity)	70°F Entering Water	4.6 COP
Source: Consortium for Energy Efficiency, http://www.cee1.org/com/hecac/hecac-main.php3.			

Table 6 – Package Terminal Air Conditioners and Heat Pumps, Electrically Operated

Equipment Type	Size Category	Required Efficiency
Air Conditioners & Heat Pumps (Cooling Mode)	< 7,000 Btu/h	11.9 EER
	≥7,000 Btu/h and < 10,000 Btu/h	11.3 EER
	≥10,000 Btu/h and <13,000 Btu/h	10.7 EER
	≥13,000 Btu/h	9.5 EER

Table 7 – Boilers, > 300,000 Btu/Hr

Equipment Type	Size Category	Required Efficiency
Gas Hot Water	< 2.5m Btu/h	80% (t)
	≥2.5m Btu/h	80% (t)
Gas Steam	< 2.5m Btu/h	79 (t)
	≥2.5m Btu/h	80% (t)
Oil	< 2.5m Btu/h	83% (t)
	≥2.5m Btu/h	83% (t)
t = thermal efficiency		

Table 8 – Chillers

Equipment Type	Size Category	Required Efficiency- chillers with ASDs or without ASDs	Required Efficiency- Chillers with ASDs optional compliance path
Air cooled w/ condenser	All	1.20(1.20) kW/ton	N/A
Air cooled w/o condenser	All	1.08(1.08) kW/ton	N/A
Water cooled, reciprocating	All	0.795(0.72) kW/ton	N/A
Water cooled, rotary screw and scroll	< 150 tons	0.75(0.60) kW/ton	N/A
	≥150 tons and < 300 tons	0.64(0.49) kW/ton	N/A
	> 300 tons	0.62(0.49) kW/ton	N/A
Water cooled, centrifugal	< 150 tons	0.66(0.56) kW/ton	0.69(0.54) kW/ton
	≥150 tons and < 300 tons	0.60(0.51) kW/ton	0.62(.49)KW/ton
	> 300 tons	0.55(0.47) kW/ton	0.57(0.45)KW/ton

a. Compliance with full load efficiency numbers (not in parentheses) and IPLV numbers (in parentheses) are both required.

b. Systems with single chillers that operate on 460/480V require ASDs. ASDs are optional in multiple chiller systems.

c. Water-cooled centrifugal water-chilling packages that are not designed for operation at ARI Standard 550/590 test conditions (and thus cannot be tested to meet the requirements of Table 2.5.5) of 44* F leaving chilled water temperature and 85* F entering condenser water temperature shall meet the applicable full load and IPLV/NPLV requirements.

Table 9 – Absorption Chillers

Equipment Type	Required Efficiency Full load COP (IPLV)
Air cooled, single effect	0.60, but only allowed in heat recovery applications
Water cooled, single effect	0.70, but only allowed in heat recovery applications
Double effect – direct fired	1.0(1.05)
Double effect – indirect fired	1.20

Table 10 - Interior Lighting Power

Use Category	Whole Building Watts/ft^2	Space by Space Watts/ft^2
School/University	1.2	
Classroom		1.2
Audience		0.7
Dining		1.1
Office		1.1
Corridor		0.8
Storage		0.8
Laboratory		1.1